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PART 3 PROBLEMS OF PIANO PLAYING AND TEACHING

Foreword

Piano playing is one of the most complex motor acts performed by the human being. Until now, virtually all attempts to analyze the physical requirements for piano performance have been directed, quite incorrectly, to the structure and function of the playing apparatus, the bones and muscles of the hands and arms.

Mr. Kochevitsky points to the area of proper concern, the working of the central nervous system, as the source of all pianistic movement and as the seat of learning for all musical performance. His approach accurately reflects current scientific opinion as to how one learns to execute skilled movements. His superb application of the principles of neurophysiology to piano performance goes a long way toward clearing the cobwebs from piano pedagogy.

Mr. Kochevitsky has been influenced by the Russian school of neurophysiologists and the Pavlovian school of reflexology. While opinions from these sources are not completely shared by American neurophysiologists, it must be understood that the workings of the central nervous system are as yet far from being clearly outlined. Experimental results in all schools have a tendency to be conflicting. From this vast experimentation, however, scientists have drawn relatively firm conclusions on many aspects of voluntary motor activity, certainly to the point where the conclusions are applicable to musical performance.

Mr. Kochevitsky has quite properly given a simplified explanation of the mechanism of the conditioned reflex and of the self-regulating processes involved in learning, the vast complexity of which would tend to obscure their application if rendered in even the approximate detail by which we now understand them.

Sumner Goldenthal, M.D.

Preface

This book represents an attempt to shed light on important problems of pianism from a new point of view.

The first part describes the history of the general development and most significant trends in piano playing and teaching. Historical perspective is particularly important, since some fallacious ideas of the past are still alive and occupy a place in piano pedagogy today, while some extremely important achievements are unknown or forgotten.

This historical survey leads up to a discussion of the main principles in the work of the central nervous system of a human being. The discussion is limited to the laws and processes pertinent to piano playing and is illustrated with practical applications of these principles.

The third part sets forth particular problems of piano playing and teaching, and explains them.

Practicing at the piano is mainly practicing of the central nervous system, whether we are aware of it or not. Misconceptions of the past have led to inefficient practicing, unproductive expenditure of time, and often deplorable results.

I believe that sooner or later piano pedagogy (as well as the pedagogy of any instrument) will have to accept the ideas and take the direction outlined in this book.

I want to express my deep gratitude to my teachers: Professors Leonid V. Nikolaev, Alexander D. Kamenski (Leningrad Conservatory), Grigori M. Kogan (Moscow Conservatory), Josef Pemhaur, Jr. (Münchener Akademie der Tonkunst); to the many fine pianists I have heard with pleasure; and to the authors of the wise books I have studied. The influence of their great ideas has, I hope, found reflection in this book.

I also wish to acknowledge my sincere appreciation to Dr. Sumner Goldenthal for valuable suggestions concerning the physiology of the central nervous system, and to thank my student Mrs. Charlotte Goldenthal for her help in polishing the manuscript.

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G.K.

PART ONE

Historical Survey of Theories of Piano Technique

CHAPTER ONE

Technique Based on Fingers Alone

INVENTION AND DEVELOPMENT OF THE PIANOFORTE

The history of both piano playing and piano teaching does not properly begin until the last quarter of the eighteenth century. Although the principle of hammer mechanics was first applied to keyboard instruments in 1709 by the Italian Bartolommeo Cristofori, its development and perfection required a long time.

Johann Sebastian Bach saw one of the first instruments of this type—Gottfried Silbermann's piano—around 1726. Although Bach praised the tone, he was not satisfied with the instrument, finding its action hard and its treble weak. He considered the pianoforte incapable of competing with the harpsichord and clavichord. Working hard to correct these shortcomings, Silbermann in 1747 again showed his improved "piano e forte" to Bach. This time Bach praised it warmly. But since this second trial took place in the presence of the King of Prussia on the court instruments, it is questionable whether Bach's praise was sincere. At any rate, Bach did not show any serious interest in the pianoforte. Possibly it was hard for an old man to appreciate such a revolutionary innovation.

Bach's son Carl Philipp Emanuel, however, in his famous *Essay on the True Art of Playing Keyboard Instruments* (1753) wrote: "The more recent pianoforte, when it is sturdy and well built, has many fine qualities, although its touch must be carefully worked out, a task which is not without difficulties. It sounds well by itself and in small ensembles."[1]

By the 1770's the pianoforte was at last satisfactory in both sound and action, so that leading keyboard composers and performers began to pay serious attention to it.

In 1773 Muzio Clementi composed his Sonata Op. 2, the first composition intended for the pianoforte and suited to it. Although there were earlier isolated compositions "for harpsichord or pianoforte," their texture and technical exposition were not specifically designed for the new instrument. Interested in the new instrument as such, Clementi indulged in experiments and tried all sorts of technical and coloristic effects. In his compositions we can clearly see for the first time a musical texture that is distinctly characteristic of the pianoforte. Clementi may truly be considered a creator and founder of the piano technique of the nineteenth century. Availing himself of the advantages and peculiar qualities of the pianoforte, he enriched his compositions with octave, tremolo, double third, repeated note and cross-hand passages. He can rightfully be looked upon as the forerunner of Beethoven, at least in the realm of technical exposition.

In 1777 the young Wolfgang Amadeus Mozart in a letter to his father described with enthusiasm the pianoforte made by Johann Andreas Stein, Silbermann's workman and disciple, and wrote that his Sonata in D major (evidently K. 284) "comes out incomparably better on the Stein pianoforte."

The March, 1783 issue of C. F. Cramer's *Magazin der Musik* mentioned "good instruments with newly invented hammers out of which the player may expect full satisfaction." Four years later the same magazine published a letter from Bonn which said that "the piano is greatly admired here. We have several instruments by Stein from Augsburg.... The young Baron von Cudenau plays the pianoforte splendidly and so does the young Beethoven."

Thus, the pianoforte gradually gained the approval of composers, performers and listeners. This recognition was accompanied by a long and tenacious struggle between the dying clavichord and harpsichord, and the new pianoforte. The outcome of the struggle was determined by historical developments.

Toward the middle of the eighteenth century, Europe went through some violent social upheavals. Great ideological changes took place. These were doubtless responsible for significant stylistic changes in music, both in the creative and recreative fields.

A new listener appeared. This new consumer preferred emotional expression to the forms of composition previously prevailing. The florid design of rococo style was replaced by simple expression of natural feeling. Subjective emotions came to take the place of objective esthetic enjoyment. These tendencies reached their peak toward the end of the eighteenth century. It was a period of *Empfindsamkeit*, "sensibility," the impulsive and dynamic art propagated by Jean Jacques Rousseau.

Such changes predestined the decline of the harpsichord, an instrument limited in expression of feeling, incapable of dynamic shadings. The gradually increasing preference for the clavichord as opposed to the harpsichord began long before the middle of the eighteenth century in the tendency to use crescendo and diminuendo as means of expression in performance.

François Couperin, in the preface to his first book of pieces for the harpsichord (1713), wrote: "I shall be forever grateful to anyone, who by infinite art and good taste succeeds in making this instrument [the harpsichord] capable of expression. . . . It seems a fruitless hope up to the present time that soul can be given to the instrument."

Several attempts were made to build harpsichords capable of producing gradual changes in tonal volume. One of these used a device called the Venetian Swell, which, operating on the same principle as the venetian blind, allowed the performer to produce crescendo and diminuendo by opening and closing louvers with a pedal.

By comparison, the clavichord was better able to satisfy the growing need for emotional expression. If we consider its tender singing tone, its ability to produce subtle dynamics and a vibrato effect (the so-called *Bebung*), the swiftly growing popularity of this instrument at that time is quite understandable. On the other hand, music, having abandoned the aristocratic salons, now had to serve a growing new audience. The keyboard instrument had to be heard in large halls and therefore had to have a more powerful tone than the clavichord could supply. The gradual crescendo up to a forte and fortissimo followed by a sudden drop to pianissimo or a gradual diminuendo, the frequent sforzandos, the combination of leading melody and harmonic background, hence the need for tonal balance. . . . All these dictated the necessity for greater dynamic mobility and flexibility than the clavichord was capable of yielding.

The new pianoforte could produce not only what is generally called "expression," but also enough volume to be heard in a large hall. Consequently, toward the end of the eighteenth century the much improved pianoforte finally gained a victory, and the production of the older keyboard instruments was discontinued.

FIRST APPROACHES TO PROBLEMS OF PIANO TECHNIQUE

During the transitional period, there occurred a rather strange misunderstanding. The heritage of the pianoforte included instruments, performers, teachers, composers and compositions. To be sure, the music for the old instruments immensely enriched piano literature, both in quantity and quality. But composers who had been writing for the harpsichord and clavichord, in creating music for the pianoforte actually transferred the old technique and style of composition to the new instrument. Their technical exposition differed little from that intended for the old instruments. This in itself was not bad: the qualities of the new instrument gradually influenced the creation of a new style. But performers, and especially teachers, became guilty of certain fallacies in their outlook on the fundamental relationship of performer and instrument.

Old and new instruments had similar keyboards, but they differed in tone quality and mechanics—hence, in touch. The technique of playing the older instruments and the new one had little in common.

Control of the speed of the key's downward movement is a point of first importance in piano playing. Therefore, fine work of arm muscles is needed for the regulation of weight and impetus, and is one of the basic problems of piano technique.

This problem is absent in harpsichord technique where preciseness of attack of finger on key (articulation) is of first importance. The clavichord is nearer to the pianoforte in this respect; still, the key manipulation for the two instruments is quite different. The problem of the legato effect on the piano is also completely different from that on the older instruments.

Already the first pianofortes were accused of fatiguing the player's fingers because of their hard action in comparison with the much lighter action and shallow key descent of the older instruments. Unfortunately, the difference between the touch on the older instruments and on the first pianofortes was not great enough to stimulate the idea of approaching them differently. Instead of taking this difference into account, the principles of harpsichord playing—utmost economy of movement and active work of isolated fingers—were maintained for a very long time. Early pianoforte technique was considered to depend entirely on the agility of the fingers.

Since the action of the keys was still rather light, not much force was required from the playing apparatus as a whole, and that of the fingers seemed sufficient. It was believed that one could develop his fingers successfully only when their action was isolated from the "disadvantageous" influence of the hand and arm.

About the end of the eighteenth century another variety of pianoforte made its appearance. This was the instrument introduced by the famous English piano-maker John Broadwood. The mechanism of this instrument was distinguished from the so-called Viennese mechanism by the deeper fall and much heavier action of the key, which made it possible to produce a fuller singing tone. (This difference gradually disappeared as the two types of instrument became similar in structure.)

So the pianoforte developed and changed, and soon the percussive touch, which formerly seemed agreeable because of the soft sonority of the first pianos, became inadequate. The orchestral approach to the instrument and the expressive performance of a singing melody enveloped in rich figuration required variety of touch and hence, more exact control over key manipulation.

Beethoven's titantic power of creative imagination brought forth new forms of technical exposition and made enormous demands on pianists and piano-makers alike. The materialization of a new tonal ideal was under way.

Composers wrote piano pieces which called for greater physical endurance as well as technical brilliance from the performer. Owing to the taste of the general public and to the conditions of performance in large halls, pianists strove to enrich and increase their tonal capacities. So a set of rather complicated technical problems arose for the pianist: for instance, overcoming the resistance of the keys due to their greater depth and heavier action.

Consequently, with changes in the pianoforte itself, some expansion took place in performing technique. It is surprising that these changes did not influence piano pedagogy, which still taught the principle of isolated finger technique and prohibited use of the upper parts of the arm.

Some attempts, however, were made to meet the changing demands. Two main trends can be traced in the striving for solutions to the new problems. The first urged the pianist to increase the strength of his finger stroke by lifting fingers high with hand arched, or by use of the so-called snap. This is the touch used in playing the harpsichord, which implies a drawing in of the fingertip toward the palm after striking the key.

From the anatomic-physiological point of view, this would definitely solve the problem of increasing the power of the finger stroke, but this action could easily cause stiffness in the entire upper part of the arm and especially in the hand and wrist. Unfortunately, not enough attention was paid to this fact—with the deplorable results that we will talk about later.

The second trend recommended increasing the strength of the finger by pressing into the key; for this purpose, a higher seat was suggested. This was actually an unconscious attempt to bring the upper parts of the arm into play. But consciously, the old principles were maintained and strictly enforced.

The majority of early piano teachers simply continued to apply the technical principles of the old keyboard masters. Even at the end of the nineteenth century, piano teachers and writers on piano playing and teaching referred to the rules stated by the old clavichord and harpsichord players. The noted musician Hugo Riemann in 1893 called on piano teachers to follow Rameau's instructions concerning technique found in his *Pièces de clavecin, avec une méthode pour la mécanique des doigts* (1724)—Rameau, who most probably had never seen a piano!

Only toward the beginning of the present century did theorists of piano playing begin to declare that it was a great mistake to carry over to the piano the modes of playing the old instruments. It took about one hundred years to recognize and attempt to correct this enormous error.

THE FINGER SCHOOL

Piano pedagogy within the first hundred years of the piano's existence was built on three commonly recognized principles: (1) Only fingers should be used; consequently, the upper parts of the arm should be fixated. (2) Technical training is a purely mechanical procedure, requiring many hours of daily practicing. (3) The teacher is the absolute authority.

Since such teaching concentrated on the action of the fingers, this trend in piano pedagogy has been called the finger school. All instruction of this school was empirically based on the personal experience of the teacher and on the belief in his infallibility. No attempt was made to find a more objective foundation. Sometimes this pedagogy confined itself to direct imitation: the teacher would play a piece at a second piano, allowing the pupil to follow him. So Theodor Kullak, according to Amy Fay, "would repeat a passage over and over, and I after him, like a parrot, until I had gotten it *exactly* right."[2]

Muzio Clementi's *Introduction to the Art of Playing on the Pianoforte* was one of the earliest actual piano methods. Earlier ones considered the harpsichord and clavichord mainly, sometimes discussing the pianoforte only as a side issue. Not only was Clementi the first to write specifically for the pianoforte and probably the first person to be designated as a *pianist*, but he was also the creator of the pedagogical etude as a means of acquiring technique.

Clementi believed that all five fingers must be equally strong and therefore equally trained. For this reason he required the pupil's hand to be kept immobile and the fingers raised high and brought down on the keys with great power. He used a special exercise for individual fingers: while each finger in turn repeatedly strikes its key, the other four fingers hold down the other keys within the five-finger position. He was one of the first to stress the necessity of practicing many hours daily. He

was so industrious in this respect that if he could not manage to practice the needed number of hours in the course of one day, he would make up the time the next day.

Similarly, Johann Nepomuk Hummel thought that the most important factor in technical perfection was absolute control over finger work. Therefore, in his *A Complete Theoretical and Practical Course of Instructions on the Art of Playing the Piano Forte* he offered over two thousand short, mainly static exercises for various combinations of fingers. He insisted that even on English instruments "passages which require to be executed with strength, must, as in German instruments, be produced by the power of the fingers, and not by the weight of the arms; for . . . we gain no louder sound by a heavy blow, than may be produced by the natural strength and elasticity of the fingers."[3]

Several decades later Adolph Kullak, the renowned theorist of piano playing, wrote in his *Aesthetics of Pianoforte Playing*: "Hummel still slights the mechanical side; with him the development of the hand has not yet become a product of purely technical work. . . ." The hand becomes a "perfected mechanism," Kullak adds, "through the aid of a later systematization of method which, though intellectually deadening, nevertheless works quickly."[4]

This perfect systematization was achieved by Karl Czerny, whose *Complete Theoretical and Practical Piano Forte School* was an encyclopedia of the pianistic knowledge of the time. Czerny believed that finger development must be built solely on mechanical gymnastics. He wrote many thousands of etudes—short and long—for almost all the problems that the pianist of that period was likely to face during his lifetime. His method was one of endless repetition, of constant pecking at one spot. If something did not turn out well, he recommended playing the passage again and again until it was worked into the fingers.

Czerny believed in first developing technique independently from music, then making this technique eventually serve for the realization of artistic aims. For the first time the full separation of mechanics and music was pronounced clearly and frankly.

In the introduction to the famous *The Virtuoso Pianist* by Charles Louis Hanon, we find "a very simple solution" for the problem of piano technique: "If all five fingers of the hand were absolutely equally well trained, they would be ready to execute anything written for the instrument, and the only question remaining would be that of fingering, which would be readily solved." Evidently Hanon succeeded in convincing the pianistic world, for his book of exercises has enjoyed exceptionally large circulation up to the present day.

A small book entitled *How to Practice on the Piano* by Heinrich Ehrlich, a well-known pianist and piano teacher, was published in Germany in 1879. The author found that holding the upper arm free was, especially in the first years of study, often detrimental to a correct position of fingers, hand and wrist and recommended pressing the upper arm tightly to the body. He prescribed lifting the fingers as high as possible, bending them, then striking. He admitted he got this idea while watching recruits learning to march with the goose step.

The most dreadful aspect of this story is that Ehrlich's book received high praise from leading piano teachers of those days, and not only went into its second German edition in 1884 but was translated into English and published in New York as late as 1901. By that time, new trends in piano pedagogy had left similar ideas far behind.

In earlier books on the art of playing keyboard instruments, much attention was given to music and little to mechanics; but in those dating from around the beginning of the nineteenth century, technical discussions took up the greater part. The more stress was laid on mechanical practicing, the kind of practicing which is time-consuming and unproductive, the less attention was paid to musical values.

The striking example of this turn of events is represented by Georg S. Löhlein's *Klavierschule*. In the first edition of this method we do not find any discussion of finger mechanics. Note reading, rhythm, measure, tempo, embellishments and music theory are expounded. This *Klavierschule*, in common with all the methods of the eighteenth century, was a book on music theory, in contrast to the more practical pianoforte methods of the nineteenth century. Undertaken by A. E. Müller and published after Löhlein's death, the sixth edition of this book appeared in 1804 with the title *Klavier- und Fortepiano-Schule*. The theoretical part stayed almost unchanged; but to this were now attached a great many pages of exercises, including some in double thirds, written mainly for hands together in parallel motion.

The attention of all piano teachers was concentrated on the development of technique. Superficial brilliance was very much in the air. Technique was developed to such perfection that it seemed sometimes to exist for its own sake.

The majority of pianists succumbed to the temptation. The development of technique was furthered by taking up each detail separately and training it to the very height of perfection. So pianists appeared who specialized in some particular kind of technique: Dreyschock was famous for his octaves, Willmers for his trills, Steibelt for his tremolos.

MECHANICAL DEVICES

If Czerny turned practicing into finger gymnastics, his gymnastics were still performed at the sounding keyboard. It is hard to find out exactly when the idea of mechanical training away from the keyboard sprang up. Probably François Couperin was an early advocate of it. But

Gymnastics for the Fingers and Wrist by Edwin Ward Jackson (1865) appears to be the first book on this subject. At least so the author claimed.

Having first discussed the anatomy of the hand with the help of diagrams, he wrote: "The head and the fingers ought to go together; but how is it possible if the latter remain behind?... Let the fingers first be properly trained; then head and fingers will go harmoniously together." Muscles and tendons were to be exercised, but "... musical instruments ought not to be used as gymnastic implements."[5] "No student ought to begin to learn or to play the piano, violin or other musical instrument ... before having set the joints of his fingers and hands in order, by means of preparatory gymnastic exercises."[6] Jackson recommended two kinds of exercises: free gymnastics and mechanical ones done with specially made cylinders, sticks and boards.

Such practice later proved to be useless and even harmful. Yet some elements of gymnastic training away from the keyboard continued to be advocated and may even be met today. As late as 1954, Hedy Spielter in an article in *Musical America* recommended practice on a dumb keyboard to make pupils more alert mentally and to develop a sense of touch. One wonders how touch can be taught without the resulting tone which is the object of the act of touch!

In the search for correct practicing, the old school sometimes resorted to the use of mechanical devices. One of the first of this kind was the Chiroplast, invented by Johann Bernhard Logier and patented in 1814. It consisted of two horizontal rods fixed above and in front of the keyboard. The wrist was supported by the lower rod, which prevented the arm's weight from pressing down upon the hand and fingers. The hand, prevented from lifting by the upper rod, was free to move laterally only. Thus, one more step was made toward mechanizing piano practice.

The pianist Friedrich Wilhelm Kalkbrenner offered his own hand-guide (1830), a mere simplification of Logier's device. Kalkbrenner's hand-guide was confined to a single rod, which prevented the hand from dropping. He believed that finger velocity could develop sooner if the pupil were freed from carrying the weight of his hand. Since hand position was thus taken care of, Kalkbrenner recommended that to avoid boredom the pupil read a book or newspaper in the course of his hours of finger exercises.

During the last quarter of the nineteenth century, the German music magazine *Der Klavierlehrer* was still seriously discussing the advantages of various machines for developing piano technique. Among numberless such devices was the Dactilon. Invented by the brilliant pianist Heinrich Herz (1806-1888), the Dactilon consisted of ten rings through which the fingers were placed. The rings were suspended by strings, which in turn were connected to springs. Thus, the finger moving down to press the key had to overcome the pull in the opposite direction. In the late 1880's Theodore Presser, editor of *The Etude*, introduced this torture instrument to the pianists of the United States.

In 1909 an article, "Reconstructing the Hand," by Harriette Brower (who also wrote several books on the subject of piano mastery) appeared in *The Musician*, a magazine published in Boston. Here we find a recommendation for gymnastics on the table, with spools between the fingers. Further, she suggests that one read a book and only from time to time look to see whether the fingers are moving in the right way.

So we see that Logier and Kalkbrenner were far surpassed by their zealous followers.

As an end to this sad chapter we should mention what may have been the extreme point reached in the endeavor to increase the strength and independence of fingers.

In the 1880's there was wide discussion in musical as well as medical magazines of an operation to cut the tendons between the fourth and fifth fingers. Some people believed that with one simple cut a new era would be opened in piano technique, less practice would be needed, and learning to play the piano would be made easier. Many such operations were performed in the United States. European doctors were more cautious. They warned that the operation was not as simple as some people thought, that no wound was without danger, and suggested not risking even a small operation where a harmless, even if more difficult, means—practice—leads to the goal.

After several years of vehement discussion the whole idea was abandoned.

CHAPTER TWO

Participation of the Arm

PROGRESSIVE IDEAS IN NINETEENTH-CENTURY TEACHING

Fortunately, there also were musicians in the nineteenth century who were opposed to the dominant ideas in piano pedagogy, and who turned away from the mechanical principles of the old school.

Although Friedrich Wieck in the earlier period of his teaching used Logier's Chiroplast in certain cases, his first concern was with the formation of touch and with teaching his pupils to listen and to hear, "just as singing teachers rely upon the culture of a fine tone."[7] He insisted that one must practice with a clear mind and "not in a way that kills intellect." With beginners he postponed the teaching of notes for about a year, thus devoting the first year to the development of the ear and to the awakening of musical activity. This was quite an innovation at that time.

Frédéric Chopin did not like to give piano lessons and did not pay much attention to piano pedagogy. Yet he had some very interesting ideas. His approach to the keyboard was unusual. He believed that the most natural and convenient position of the fingers was to place long fingers on short (black) keys and short fingers on long (white) keys. That is why he prescribed that the first exercise be done on *e, f* sharp, *g* sharp, *a* sharp and *b* (for the right hand), and assigned B major as the first scale. Five-finger exercises as well as scales were to be played with various degrees of nonlegato touch at first, and only afterwards was legato to be introduced.

Believing that it is important to make use of hand, wrist, forearm and arm, Chopin suggested that while playing a scale one should move his arm laterally along the keyboard. In scale, arpeggio and like passages, Chopin insisted on not turning the hand when the thumb passes under or the fingers pass over. He preferred, in the early period of study, that his pupils *not* connect the tones rather than change from the normal position in which the hand forms a straight line between forearm and key. In his compositions we see some quite new forms of technique: passages shifting smoothly through several hand positions, requiring skillful horizontal movement of the arm combined with suppleness of the wrist.

Chopin taught various kinds of touch, paying special attention to legato and cantabile. When he said, "He is unable to connect two notes"[8] (referring to phrasing, as well as to legato), this was most severe criticism. He suggested that in order to learn to sing on the piano, pupils should listen to good singers.

Kalkbrenner, too, said that he learned more from the great singers of his time than from any of the pianists; and Thalberg wrote in the Preface to his *L'Art du Chant Appliqué au Piano*: "No opportunity should be missed of hearing great instrumentalists, and singers in particular." Anton Rubinstein, who was famous for his singing tone, told of having been impressed by the singer Giovanni Battista Rubini, and how he tried to imitate his singing while playing the piano.

There was nothing new in these ideas. These pianists took the legacy of the eighteenth-century masters: C. P. E. Bach wrote that one has to listen to good singers and has to study voice whenever possible. Later G. F. Wolf (1783) repeated the same suggestion: "The clavier player who cannot sing or think singingly will never be able to perform anything with singing tone, and that is the main thing in clavier playing."[9]

Although Robert Schumann did not busy himself with piano teaching, he wrote much about music and musicians. He thought that exercises, scales and etudes could be useful, but that to practice mechanical exercises for many hours would be as absurd as trying to pronounce *A, B, C* faster and faster every day. He considered it better to study a complex musical composition comprising all possible kinds of difficulties and offering good material for technical work.

Schumann believed that the ability to listen to oneself was most important to a musician-performer. He suggested that the pianist first mentally perceive the essence of a composition instead of digging and hacking "away at it, bar by bar."[10] He wrote: "Do not play the musical composition before you can hear it inwardly."[11] "The finger must do what the head wills, not vice versa."[12]

Although Franz Liszt did not leave any detailed exposition of his pianistic and pedagogical principles, he sometimes expressed his opinions in letters, and his ideas found reflection in his pupils' writings. His development as a pianist and piano teacher can be traced by analyzing his compositions of different periods. His *Technische Studien* (1868-1879) and three editions of *Etudes* (1826, 1837 and 1852), in the last version called *Etudes d'exécution transcendante*, are especially significant. In the first edition of the *Etudes*, traditional ideas are still in evidence. In the second edition, these *Etudes* are transformed into brilliant virtuoso compositions. Here we see a rich variety of new technical forms. But behind the abundance of difficulties, the musical idea sometimes grows obscure. Finally, in the last edition, Liszt completely subordinated technique to the highest and most refined poetic expression.

While Liszt in his young days subscribed somewhat to commonly accepted views on developing piano technique, basically he held different views and gradually formed his own ideas, compatible with the most advanced ideas of the twentieth century.

Liszt was not a "professor of piano." He did not talk about technique: pupils were supposed to work this out for themselves. "He leaves you your own conception. Now and then he will make a criticism or play a passage, and with a few words give you enough to think of all the rest of your life,"[13] wrote Amy Fay.

Liszt stressed the importance of grasping the spirit of a composition. Only the strength of musical imagination can guide one in his search for technical skill and show him the right direction: the body will find the necessary movements for realizing the musical idea. Technique not only serves the artistic goal but is itself generated by the tonal image.

According to Liszt, technique does not depend on exercise, but on the technique of exercise. Analyzing technique, he reduced all difficulties in piano music to a certain number of basic formulas. A pianist who mastered these formulas would be equipped, after making some adjustments, to play everything written for the instrument. He thought that the first task of a musician was to learn to listen; that only the pianist who is able to bring his body and fingers in accord with his ears and soul could be regarded as the master of a real technique.

His symphonic treatment of the piano called forth a radical change in the entire motor skill of the pianist, requiring the use and coordination of all the muscles of the arm, shoulder and torso. The desire for a wide dynamic range required freedom and elasticity of movements, variety of positions, peculiar fingerings. For Liszt, each movement of the finger was connected with the whole process of movement of the playing arm; each rhythmical and dynamic change was linked to an inner impulse.

Although Theodor Leschetizky was one of the most successful representatives of the old school, he still realized its many deficiencies and tried to overcome them by adding new concepts. He refused to recognize exclusive finger technique and attached great importance to the wrist, which was supposed to serve as a spring. He was against mechanical practicing and required that the mind take the lead, although he had a rather primitive view of the mind's role.

Leschetizky's success can be ascribed in part to these innovations but also to the fact that after Liszt's death, in 1886, the best pianistic talents of the whole musical world came to study with him. He stood at the meeting point of the old and the new but belonged to the past.

THE IMPASSE OF THE OLD SCHOOL

New ideas in the spiritual domain of art and developments in instrumental technique influence each other. Musical and technical developments also push forward improvements in the tonal and mechanical capacities of an instrument.

During the first hundred years of its existence the piano underwent changes in construction, significant in many respects. If this development was caused by artistic requirements, conversely it was limited to a certain degree by the biomechanics of the performer.

In close connection with these changes the technical formations in piano literature expanded. As a result, the functions of the pianist's playing apparatus also changed considerably. If we compare the motor activity of a harpsichordist (or even of a pianist of the last quarter of the eighteenth century) with that of a pianist at the end of the nineteenth century, this expansion is very noticeable.

The creative imagination of composers, technical capabilities of pianists, and ingenuity of piano-makers were mutually stimulating, producing new problems that the old school appeared unable to solve.

The uncreative, routine piano teachers confined themselves to the principle of isolated fingers. They did not allow their pupils to include the free participation of the upper parts of the arm in piano playing, even though this participation was urgently demanded by the progress just described.

But in spite of piano pedagogy's disregard for many natural physiological and psychological laws, the nineteenth century still produced many truly great pianists.

Genius has its own way, which is sometimes directly opposed to the way indicated by the teacher. A truly gifted pupil threw off the fetters of the school and by his own intuition solved the problems he met on his way to mastery. He inevitably came to the idea of using not only fingers but all parts of his arm in coordinated action. We could say that piano technique developed *despite* the old system.

In the second half of the nineteenth century, the disparity between the obsolete dogma of the old school and the practices of contemporary pianism became obvious: pianists on the concert stage did not play according to the instructions of piano teachers of the time. While some teachers came to recognize the right of a performing artist to be more free in his movements, they still demanded of their pupils strictest obedience to the old rules. They reasoned that since they themselves and all other pianists had striven for, and achieved, technical perfection in the old way, what else was there to look for?

But the enormous amount of work needed for the achievement of this technique was not within everybody's power. Students whose musical talent was not strong enought to resist mechanical drill turned into artistically undeveloped acrobats incapable of creative musical expression. In the worst instances, they crippled their hands as a consequence of industrious practicing. The predominating mode of playing the piano with artificially isolated fingers strained the muscles and stiffened the hands, and thus caused serious neuromuscular disorders.

To some people it seemed that piano playing required certain unnatural movements that only a few happy aspirants could somehow attain. The old school arrived at an impasse.

All these circumstances, together with the progress of science, gave impetus to a critical revision of the old principles.

LUDWIG DEPPE'S IDEAS

No one knows how many young pianists crippled their hands by constant overstraining of comparatively weak finger muscles. But their number evidently became great enough to cause widespread discussion.

In 1885 two open letters calling attention to such cases were published in the European press. One was written by Béla Szentesy, a professor at the Music Academy in Budapest, the other, by J. Zabludowski, a doctor in the Royal Surgical Clinic of Berlin University. These two letters gave Ludwig Deppe, a noted German conductor and piano teacher, occasion to write *Armleiden der Klavierspieler* ("Arm Ailments of the Pianist").

Deppe wrote that tone must be produced, not by finger stroke—that is, not by requiring unnatural strength from the relatively weak muscles of the hand and fingers—but by coordinated action of all parts of the arm. He did not express himself fully in that short article, and he lacked objective scientific data. But through the intuition of his genius, he introduced a new idea in piano pedagogy and piano technique.

In liberating the hand and arm of the pianist, Deppe refused to consider *isolated* finger technique, though he realized very well what an important part the fingers have in piano playing. He taught that when the hand and fingers are supported and reinforced by free movements of the arm, effort is distributed over every part of the playing apparatus from shoulder to fingertips. His system insured that arm, wrist and fingers would work in natural cooperation as one complete set of machinery.

One of Deppe's basic principles called forth bitter attacks. This was the notion of the so-called free fall. The cause of some of the misunderstanding was Deppe's inability to formulate his ideas clearly. "Free fall" must be taken in a metaphorical rather than in a literal sense. Deppe's pupil Elisabeth Caland, who put down his ideas long after his death, wrote about "a seemingly free fall" and mentioned Deppe's expression "controlled free fall." But controlled fall is certainly not free fall. We can be sure that Deppe himself did not literally mean that the arm should fall freely on the keyboard, which would be pure nonsense.

Deppe required rounded and smooth movements, rotation of the forearm and upper arm, and a supple and flexible wrist. He advocated a somewhat pronated position of the hand and suggested that each finger form a straight line with its key. Then the fingers would transmit the needed energy directly to the keys.

He was opposed to hammering the keys, saying that one should not strike but should caress the keys. To strike the key in order to produce the tone would be as absurd as to strike the doorbell. He said that fingers had to be *bewusst und beseelt* ("conscious and live") and fingertips sensitive. Each finger had to work under the conscious direction of the will. He spoke of a mental map of the entire route from brain to fingertips and stressed that, together with fingers and hands, the mind should practice also.

Deppe's chief concern was to awaken a keen sense of tonal beauty in the minds of his pupils. Training the ear went hand in hand with technical training. The first exercise he gave consisted of a single tone, then two tones, three, and so on; beauty of tone was always his first consideration.

The American Amy Fay, one of Deppe's pupils, wrote that he made her listen to every tone. He required her to follow consciously the duration of each tone, to imagine the pitch and volume of the next one, and only then to transfer very carefully from that tone to the next. This is distinct from the notion of legato held by Czerny and his followers, who leaned more upon mechanical holding of the key than upon attentive listening.

In contrast with the old-school suggestion of Theodor Kullak: "Practice always, Fräulein. *Time* will do it for you some day,"[14] Deppe said that progress depended on mental vigor, and showed how to conquer a difficulty by making technique and conception identical.

Soon afterward the correctness of Deppe's ideas was confirmed by the data of physiology. It was established that when a pianist lays all the burden of work upon the weakest muscles of the hand and excludes more powerful muscle groups from the sphere of action, occupational ailments result. It became known that the muscles of the playing apparatus, finger as well as arm, could perform very fine, fast and purposeful movements only from the shoulder joint. Another finding was that motion in curved continuous lines is more economical than motion in angular straight lines.

Unfortunately, Deppe's ideas were distorted by some of his pupils and immediate followers, who were mainly interested in the question of movement and often overlooked the purpose of a movement. They did not pay much attention to that part of Deppe's teaching which required careful listening to tone quality and perceiving fine sensations, particularly in the fingertips.

Shortly after Deppe's death, advocates of so-called relaxation and weight playing appeared who seemed to revolutionize piano playing, liberating the pianist from his former restrictions. Actually, it was Deppe who delivered the first blow to the old school.

THE ANATOMIC-PHYSIOLOGICAL SCHOOL

The second half of the nineteenth century was the epoch of faith in the absolute accuracy and objectivity of science. A mechanistic approach was much in evidence at this time when "science inclined to look upon all nature somewhat as a feat of engineering."[15] Understandably enough, teachers and theorists of piano playing were caught up in this trend and endeavored to penetrate the process of pianistic work and put its principles on a scientific basis. All secrets seemed about to be disclosed. One step further and all could follow the wonderful, easy road to unlimited perfection in piano playing! Since the scientific basis of this philosophy lay in the anatomy and physiology of the bone-muscle apparatus, the school of technique arising from it has quite appropriately been called the anatomic-physiological school by Grigori Kogan.

Some representatives of this school believed that everyday human motor activity had little in common with that required of a pianist. Others tried to postulate a natural piano technique. All aimed at finding the perfect pianistic movement which would be absolute and identical for all players—a rational technique working like an ideally constructed motor.

One of the most important books of this school was *Die Natürliche Klaviertechnik* by Rudolf Maria Breithaupt, published in 1905. It created a sensation and ran into five editions during the next sixteen years. Hardly any book in the whole history of pianism enjoyed such a success, despite Breithaupt's contradictory statements and outright errors. It was translated into many languages, although mostly in abridged form. The Breithaupt doctrine spread wherever people studied the piano and reigned supreme for almost two decades.

As a consequence of severe criticism, Breithaupt thoroughly revised his book, and the third edition (1912) appeared as an almost new work. Breithaupt gave up some of his more extreme positions and softened the sharpness of his tone.

Besides the form of movement, two other ideas occupied the representatives of the anatomic-physiological school: weight playing and relaxation, terms which came to be on the lips of almost every piano teacher and student. The idea of weight playing was not altogether new, however; Adolph Marx, Adolf Kullak, Ludwig Deppe and others had already spoken of it.

Breithaupt, a fervent proponent of this idea, proclaimed that the most important principle of technique was a loose and heavy arm: "The light arm idea is physiologically completely fallacious and technically wrong"[16] (*Die Natürliche Klaviertechnik*, 2nd edition). Then he came to a confusing and vague conclusion. In the third edition of the same book he wrote that the ultimate ideal of artistic performance is "predominance of the spirit over the body, liberation from the material, *the overcoming of the pull of gravity*: only a fine sense of balance is left from the latter.... It goes without saying that in the cases of greatest speed the weight seems almost eliminated."[17]

The idea of relaxation brought with it another danger, that of weakness and looseness. One of Breithaupt's partisans, Anna Roner, wrote in 1916: "We learn full relaxation as a preliminary exercise only ... each tone, even the softest one, requires a very slight degree of tension."[18]

Finally, we have the anomaly of Tobias Matthay, the most ardent exponent of the relaxation idea, complaining that he was misunderstood. Some thirty-six years after his first book appeared he wrote: "Relaxation does not lead to flabbiness ... it does not imply the omission of exertion needed in all playing.... It has been quite wrongly assumed that by weight touch is meant that tone is produced by the the lapse of weight [evidently he meant dropping the weight], without the intervention of finger and hand exertion."[19]

Unlike the old school, which seldom expressed its ideas in written form, the anatomic-physiological advocates flooded the musical world with countless books and articles on piano playing and teaching, usually starting with a detailed exposition of anatomy as well as of mechanics. True, it had been pointed out that description of muscles was useless for discussion of piano-playing problems. (Even Matthay wrote that it is a "precarious and mis-

leading method . . . to instruct as to the precise *locality* and *nomenclature* of the muscles employed.")[20] Yet the representatives of the anatomic-physiological school continued to fill their books with descriptions, charts and photographs of arms, bones and muscles.

The anatomic-physiological school subjected to special derision playing with isolated fingers (one of the basic tenets of the old school) as well as fixation of the upper parts of the arm. It prescribed swinging rotary movements of the upper parts of the arms as a substitute for active finger work.

The struggle against the dogmatism and authoritarianism of the old school was very much in evidence. The student was encouraged to reason out the necessity and logic of this or that approach to a given technical problem rather than to obey the teacher's prescriptions blindly.

Representatives of the new school believed that perception and conscious training of the correct movement would substitute for mechanical exercises. Some went so far as to believe there was no need for many-hours-a-day practicing. To solve complicated technical problems almost instantly one need only understand which limbs, which muscles are involved, what they have to do, and how they have to do it.

Having failed to understand what could and could not be consciously perceived in piano playing and practicing, they said that to prevent muscle overstrain, one must use only the muscles needed for this or that movement. They ignored this fact: the laws of work of the central nervous system, which directs our motor activity, exclude any possibility of making such calculations while playing, and limit the ability to control muscle work while practicing. Although muscles need regulation, and indeed extremely fine regulation, this has to be achieved in a quite different way.

When the adherents of the anatomic-physiological school started to use scientific data, they mistook their superficial knowledge of muscle activity for unshakable truth and applied it to piano playing.

Later, in 1927, Grigori Prokofiev, a Russian piano teacher and author, wrote: "When the theorists of pianism tried to describe the work of the muscles and to draw the picture of the arm as a whole or in part, these descriptions made the physiologists tremble."[21]

The superficial information of the anatomic-physiological school led to an overestimation of the scientific knowledge of the time, even though contemporary scientists admitted that little was known about human motor activity. Even today, we cannot observe or control the fine play of muscles. We know that muscles receive messages to contract or to relax and that they react to these orders, but there is much in this process that we do not understand. The sequence of events in the contraction of muscle cells is still in question; so is the sequence of contractions of muscle groups.

Becoming entangled in scientific problems, the anatomic-physiological school carried over the laws of physics from the piano to the live human being. Conversely, they applied physiological laws to the dead mechanics of the instrument, thus confusing physics and physiology. So Matthay, discussing the relationship between finger and key, wrote that the key is the continuation of the finger—a seemingly fine but dangerous definition!

The anatomic-physiological school underestimated the importance of finger work and the necessity for exertion of involved muscles. Some extremists believed that the fingers should merely passively transmit the weight and strength of the whole arm from the shoulder into the keys. Too much importance was attached to swinging-rotary movements of the upper parts of the arm. When these movements substituted for finger activity, precision suffered, although piano playing became easier.

The cause of the failure of the anatomic-physiological school as a whole lay in its simplified and limited understanding of physiology as the mechanical work of joints and muscles. It did not take into account the more important aspect of technique—the work of the brain, of the central nervous system, which directs and controls the activity of our playing apparatus.

Both the finger school and the anatomic-physiological school looked for a solution of pianistic problems in the periphery of the playing apparatus. The former concentrated on fingers, the latter assigned the main role to the arm. Although both schools failed, the older one could nevertheless boast of having produced outstanding pianists. The finger school was able to lay a foundation, even though not quite sound, on which the talented performer could grow and develop.

And yet we have to acknowledge that the anatomic-physiological school brought to piano pedagogy some sensible and progressive ideas. It made a step forward, for it stimulated a review of obsolete ideas, fought against authoritarianism, and turned to science. There was no way back to the old naïve dogmatism. Although the new school failed to solve the problem of pianistic movement, at least it exposed the absurdity of the finger school, even if in so doing it exposed its own as well.

Finally, for those whose futures were threatened by the pernicious rules of the old school that created actual physical disabilities, the new school appeared as a revelation. There could be no doubt that many injured pianists were cured. Those who had developed good finger technique, after going through anatomic-physiological school treatment, liberated their playing apparatus and could continue their pianistic activity. They were spared the aftereffects of the new school's ruinous neglect of fingers.

The extraordinary success of the anatomic-physiological school should be ascribed mainly to an emotionally tinted and deceptive point—the appeal of an effortless technique.

CHAPTER THREE

Growing Awareness of the Role of the Mind

NEW THEORIES OF MOVEMENT AND EXERCISE

In 1881 the noted German physiologist Emil Du Bois-Reymond delivered a famous speech on the physiology of exercise. This speech made a great sensation. The opinions advanced by Du Bois-Reymond were new at that time. They smashed the established notions about the mechanism of movement and the process of developing skillful movements with the aid of exercise.

Du Bois-Reymond said that motor activity of the human body depends upon the proper interaction of muscles more than upon the force of their contraction. The muscles involved in any composite motion must work in the proper order. The energy of contraction of each muscle must increase, halt and diminish according to a certain law and with precise timing.

Since the nerves transmit impulses from the motor cells of the brain to the muscles, and the muscles instantly obey these orders, it is clear that the mechanism controlling complicated movements is located in the central nervous system. Consequently, all bodily exercises are not mere gymnastics of the muscles but involve the whole nervous system. The more one practices a complicated movement, the more unconscious the activity of the central nervous system directing this movement becomes. Composite movements require consideration of visual, tactile and kinesthetic senses. The sensory nervous system as well as the mind needs exercise and is capable of improvement. Exercise fits man's nervous system for the most complicated functions and sharpens his senses. With the help of exercise, the human mind, reacting upon itself, can increase its own elasticity and versatility.

It is possible to strengthen the muscles and increase their endurance, but it is impossible to achieve the skill to execute complicated movements by gymnastics alone. A man with the muscles of a Hercules could be very clumsy in his walking, to say nothing of more complicated movements. To perform complicated movements one needs a *sense of purpose and expediency.*

In 1837 the German physiologist Johannes Müller had found that perfection of a movement involved the suppression of unessential by-motions as much as it did the acquisition of speed of necessary motions. Du Bois-Reymond said that even though we know nothing about the mechanism for the suppression of by-motions, we know the usual result of normal exercise is not the strengthening of muscles. Later (1904) Dr. Semi Meyer wrote that the only possible physiological explanation of increase in speed by means of exercise is the time gained through avoiding inexpedient by-motions in the initial stage of learning the motion.

Du Bois-Reymond mentioned that while the playing of Franz Liszt or Anton Rubinstein would be inconceivable if they hadn't had iron arm muscles, the secret of their virtuosity was located in their central nervous systems. Their virtuosity consisted in unusually fast and fine perception of auditory and muscle sensations, in very rapid transmission of the commands of brain to muscles, and in the fine gradations in strength and timing of motor impulses. Quoting Lessing, who asked whether Raphael would have been any the less great a painter had he been born without hands, Du Bois-Reymond observed that Lessing had perceived the truth. The roots of talent are in the gray substance of the brain, not in the hands.

Du Bois-Reymond was the first scientist who, speaking of bodily movements in general and practicing in particular, touched directly upon questions of piano playing and explained some very important points. Unfortunately, during the following decades physiologists did not show any special interest in the problems of piano pedagogy.

Nor did the majority of piano teachers pay attention

to the views expressed by Du Bois-Reymond. They did not try to analyze, to comprehend and apply to specific cases the scientific achievements of their time.

OSCAR RAIF'S EXPERIMENTS

Amid all the noise made by those who came after Deppe, a pianist and teacher by the name of Oscar Raif made some extremely interesting experiments.

The results, obtained from pianists as well as non-pianists, showed that on an average a person could make from five to six movements a second with the second and third fingers, and from four to five movements a second with each of the other fingers. As a rule, educated intelligent people were capable of greater finger agility than people of lower intellectual levels. But trained pianists by no means had greater mobility of the individual fingers than did people who were not pianists. While some persons who had never played the piano could easily make as many as seven movements with one finger in a second, a number of good pianists were able to make only five.

This seems surprising only if we overestimate the activity of the separate fingers in piano playing. The requirements of an individual finger in piano playing are usually much less than its natural ability. The normal mobility of a single finger is fully used only in performing a trill. A trill consisting of from eight to twelve tones per second requires four to six movements of each of the respective fingers. But since the human ear ceases to accept as musical a succession faster than twelve tones per second, Raif concluded that the limit of our finger agility coincides with the limits of our auditory perception.*

Thus, a two-octave C major scale played during one second would give the impression of the fastest possible tempo. But how many movements would each finger perform to achieve this speed? First, second and third fingers—four movements each; fourth finger—two movements; fifth finger—only one movement.

*Dr. Ernst Jentsch found (1904) a slightly higher ability of the human ear for perception of a fast succession of tones. But the limit of this ability is individual and depends on certain conditions: familiar or very regular and simple successions are perceived much more easily than irregular and more complicated ones. In the case of the trill or tremolo we can perceive up to fifteen tones per second without tones merging in our ear. The same can be said about simple scalelike successions of tones. But the more complicated, irregular and unusual the successions, the more difficult it becomes to distinguish separate tones. In such cases, the level of our ability for perception is lowered to only six tones per second. These complicated successions have to be played slower for clear perception. Dr. Jentsch added that a fast succession of lower tones is more difficult to perceive than one of higher tones because of the overtones. Therefore, what sounds clear in a higher register would sound muddy in a lower register.

The ability of the ear to perceive rapidly changing tones accurately grows with the pianist's musical development. As he has more musical experience, he is able to accept more easily a complicated succession of tones. But this growth is certainly very slight.

When a pianist plays the last movement of Chopin's B-flat minor Sonata, for example, his performance is considered to be about as fast as possible. But the metronome shows that only twelve tones are played in a second, so that participation of each individual finger is completely within the natural boundaries of its ability.

Raif observed his students for several years and recorded that while the tempo limit in their playing of five-finger exercises, scales, arpeggios and so forth increased considerably as a result of constant practicing, there was no increase in the agility of their separate fingers. Besides that, after having determined that their limit of velocity for playing these technical formations in the right hand was ♩ = 120 (four sixteenths to the beat) and in the left hand, ♩ = 116 , he had these students practice with the right hand only. After two months, right hand velocity increased to ♩ = 186 . But velocity in the left hand, which during all this time did not touch the piano, also increased, to ♩ = 152 .

At first while playing both hands together, students had certain troubles with the left hand; but these troubles were at once eliminated when Raif let them play some scales in contrary motion. Finger succession in the left hand was now the same as in the right hand, and metrical accents fell on the same fingers.

Practicing a passage with the right hand can help the left hand, but only if the left hand has to play a symmetrically inverted succession of keys formerly practiced with the right hand. In the case of parallel passages the problem is more complicated: the left hand neural centers *practice* incorrectly, developing connections contrary to the needed ones. So the left hand would be forced to fight at first against the acquired connections and then to establish the appropriate ones.

Between identical points in both hemispheres of the brain there is a connection whereby the nervous processes taking place in one hemisphere are reproduced, with somewhat lesser strength, in the analogous points of the other. But anatomically and functionally, the right-left relationship of the hands is like a mirror reflection.

Raif concluded that it would be worthless in developing piano technique to attempt to augment the agility of each individual finger. The difficulty lies not in the movement itself, but in the precise timing of the successive movements of the fingers. Since timing is the product of perception and will, it should be clear that technique is initiated in the central nervous system. From there, movements must be coordinated as part of one action and governed by our will. Performance is based on reflex movements, but these reflex movements are secondary phenomena. The finished performance must be preceded by frequently repeated, consciously willed primary movements.

Raif made two additional observations: (1) He repeated the statement of Du Bois-Reymond that organic

change in the musculature, as the result of long practicing, can express itself in increased strength and endurance but not in increased dexterity. (2) He reminded us of what every pianist knows from his own experience, that a piece which he has heard before usually "gets in the fingers" sooner than one completely new to him.

Raif found that piano teachers, focusing their attention on the finger agility of their pupils, paid too little attention to the interaction of eyes, ears and fingers. He wrote: "We have to develop in our pupils not finger dexterity but mind dexterity."[22]

Raif died at an early age and did not finish his experiments. He left an article (his only completed written work) which was published in 1901, two years after his death.

The French piano teacher and author Marie Jaëll made experiments similar to Raif's. Her results coincided with his. But she failed to draw correct physiological conclusions and tried to increase the speed of single finger movements with the help of muscle contractions. Two German scientists, O. Abraham and K. Schäfer, confirmed Raif's conclusions.

In later writings we find a few objections to Raif's thesis. But these objections are mainly of a speculative character and do not undermine the essential value of his work.

Piano teachers paid no real and proper attention to Raif's unusually interesting and important discoveries. The anatomic-physiological school, having drawn completely absurd conclusions from his data, announced that finger exercises were unnecessary.

STEINHAUSEN ON THE PSYCHIC ORIGIN OF TECHNIQUE

The anatomic-physiological school had achieved its greatest prominence at the beginning of the twentieth century when, in 1905, several months after the appearance of Breithaupt's book, Dr. Friedrich Adolph Steinhausen's *Die physiologische Fehler and Umgestaltung der Klaviertechnik* ("The Physiological Misconceptions and Reorganization of Piano Technique") was published.

Steinhausen subjected both the old finger school and the newer anatomic-physiological school to severe criticism. He pointed out that, contrary to what leading teachers proclaimed as correct, pianists use the strength of the free arm from the shoulder to achieve effects impossible under the traditional system of finger technique.

He wrote that movements of arms, hands and fingers in piano playing are no different from those of any other parts of the body and are subject to the same laws. What distinguishes pianistic movements from other human motor activity lies not in the periphery—in fingers, hands or arms—but in the central nervous system.

Since every movement is initiated in the central nervous system, practicing is, first and foremost, a psychic process, the working over of accumulated bodily experiences and the adjustment to a definite purpose. Our whole organism shows an endless multitude of adjustments to nature and its forces, as well as adjustment of its own parts to each other. Much of this adjustment is evidently inborn; the rest is acquired during the development of the organism. Practice and adjustment embrace our whole being and life. The kind, degree and dimension of this adjustment are always regulated by the central nervous system.

The process of this purposeful adjustment is so infallible that it can seem mechanical to a superficial observer and so can lead to some wrong conclusions. In our everyday movements we act automatically. But this automatism is nevertheless a psychic process and has its seat in the central nervous system—not, as one would assume, in the fingers and muscles. The fastest movement, even though it seems to become mechanical, still is a psychic occurrence.

Steinhausen wrote that the psychic origin of a true technique shows the futility of finger gymnastics. He said that fluency in piano playing cannot be increased by repeated movement of one finger. Such gymnastics can increase the size of muscles, but this increase is of secondary importance, is normally achieved in the process of piano study and results in the increase of strength and endurance. Through practice we can learn to move our fingers at the right time and in exact succession in accordance with a given musical figure. We can also achieve the ability to make fine gradations of tonal volume. But this learning is mental and has nothing in common with the degree of muscle development. "A quantitatively small alteration in the brain has much greater importance than the most significant muscle enlargement."[23]

We do not know which group of muscles participates in this or that movement. Even if we did, this knowledge would not help us since we cannot command our muscles consciously and directly. The choice of necessary muscles takes place unconsciously, but nonetheless surely, and accomplishes the exclusion of all unsuitable interfering muscles. Beginning practice starts with *too much* expenditure of force. The elimination of too much muscle action is the real basis for developing agility. As a result of practicing, we learn to make the fluent, sure and fast movement which uses exactly as much muscle force as is needed for a given purpose.

While many old theorists of piano playing believed that technique, as something abstract, could and should be worked out separately from musical problems, Steinhausen emphasized the inseparability of the artistic and the technical.

Technique is the interdependence of our playing apparatus with our will and our artistic intentions. In the perfect technique the will and the movement appear as

one. Technique is the adjustment to artistic intentions and normally is only the means to achieve a definite goal. While the mind is dominating and determining this goal, the whole arm is "the animated tool, but always, only the tool."[24]

Steinhausen declared that the energy of a movement is conditioned by the clarity and strength of the artistic imagination which stimulates this movement. The more talented a pianist is, the more quickly and easily will his movements adjust to his artistic intentions. Thus the form of movement is determined not only by physiological laws but by esthetic considerations as well. Consequently, Steinhausen called for full physical freedom. He stated that the body, left to itself, would find the right and sure way and would never go astray: "We cannot teach our body how to move but can only learn from it."[25]

Steinhausen shared some of the fallacies of the anatomic-physiological school. Contradicting himself, he tried to solve all technical problems by finding one physiologically *correct* form of movement. But the swinging-rotary movement which he proposed (a combination of swinging movement of the whole arm with rotation of the forearm) is far from sufficient for all technical problems. The multitude of various kinds of tone quality demands from our playing apparatus a multitude of movement forms and their various combinations. Steinhausen seemed to forget his own appeal to the psyche, to the imagination, which was supposed to determine the form of movement. Believing that esthetic ideals are unchangeable and universal for all musicians, he pressed his own artistic ideals on everyone. Actually, diversity of musical conceptions calls for diversity of technical means, and there are as many correct techniques as there are different artistic intentions.

But in spite of some contradictions and fallacies, Steinhausen was one of the first theorists of pianism to outline a new and more reasonable approach to problems of piano technique. Directing the pianist's attention away from the playing apparatus to the controlling neural centers, he pointed out the importance of purposefulness and force of imagination in the development of technique.

TWENTIETH-CENTURY TRENDS

At the beginning of the twentieth century there were three main trends in piano pedagogy. Some teachers, conscious of the deficiencies of the finger school, tried to add something new to their teaching while basically retaining the position of this school. This something new could mean giving more freedom to the hand and even the arm, and not raising fingers too high; or it could lie in the realm of psychology, although expressed in rather naïve form.

Many piano teachers, however, animated and inspired by the ideas of the anatomic-physiological school, busied themselves with the problems of weight and relaxation. They searched for the most natural, correct movement forms, trying to determine which part of the arm and which group of muscles should participate in this or that movement.

The most thoughtful and advanced musicians of the time, however, started to look for the solution of pianistic problems in another direction—in the realm of intellect and psychology. They insisted that "the technical training from the 'outside' must be replaced by technical training from the 'inside'."[26] Grigori Kogan called this third main trend in the theory of piano playing the psycho-technical school.

All three trends existed simultaneously and still exist today. To be sure, such a division into three groups is somewhat arbitrary. Often there is a combination of elements of all three in varying proportions.

In the last six decades many books and articles have been written on piano playing, piano teaching, technical development and the like. Most of them appear to be a rather peculiar mixture of the old and the new, some showing complete ignorance of modern ideas and even of established facts in piano technique.

For instance, a noted German piano teacher, Theodor Wiehmayer, found that the only harm in the old school five-finger exercises was that the weaker fifth finger was used much less than the second and third fingers. Therefore, he offered exercises mainly for the fourth and fifth fingers. He did make a forward step by recommending various rhythmical patterns, stating that the old system "laid too much stress on making strong muscle, instead of the making of a strong nerve-line development from the nerve center in the brain to the nerve center in the muscle."[27] But what he meant by "strong nerve-line" and how to develop it remains unclear.

Beata Ziegler, a German piano teacher, wrote in 1928 that great pianists overcome all physical difficulties through inward hearing and artistic inspiration. But the three books of her method, especially the first one, are full of dry uninspiring exercises reminiscent of the worst of the old instruction books.

Alfred Cortot's *Principes rationnels de la technique pianistique* (1928) is a resurrection, with some modifications, of Hummel's hundred-year-old ideas. A year later Erwin Bach, taking the position of the anatomic-physiological school, introduced a minutely worked out system of movements obligatory for all pianists and to be applied in all cases. Comparing piano technique with the mechanics of a motor, he asserted that none of the great virtuosos employed really good and purposeful movements.

James Ching (1946) talked at length about the conscious control of the form (the "look") and the sensation (the "feel") of movement. He found that "to practice without this dual form of attention is merely a waste of time,"[28] but he seemed to lose sight of the indispensable third form of attention: tonal perception. Ching devoted

more than a hundred pages to the meticulous analysis of movements and their accompanying sensations, mostly not connected with tone production. He stated that: "The production of the loudest possible tone can be achieved only by a combination of the maximum possible hand and arm pressure, *the maximum finger lift* and *the application of the maximum force in respect of the movements of the individual fingers*"[29] [italics mine] —a survival of the worst of the old school!

In contrast to the prevailing tendencies, Ching separated technique from art: "*The purely technical aspects of piano playing, the ability to make the bodily movements involved in operating the piano keys efficiently is not to be gained by any reference to any questions of art, but only by reference to applied science, to the established facts of psychology and mechanics*"[30] [Ching's italics]. He forgot that in "operating the piano keys efficiently" the pianist depends primarily on his artistic ideas.

Frederick Polnauer (1952), working in the field of biomechanics, called for training the kinesthetic sense and depending "to a lesser degree on the guiding function of ear [!] and eye."[31]

In 1954, Hedy Spielter wrote in a leaflet announcing a series of lectures about her "truly revolutionary method," which "presents entirely new concepts" and "permits an absolutely *unlimited technique without any tension whatever*." But she merely repeated what had been promised by Breithaupt and his group fifty years before.

József Gát (1958) not only devoted much space to the anatomy of bone-muscle apparatus, but even recommended gymnastics away from the instrument "to facilitate correct innervation of the movements required in piano playing."[32] Often separating technique from art, Gát reminds one of the days of Czerny and the like. At the same time, he talks a little about the psychology of piano technique and even mentions conditioned reflexes, but is unable to discuss the laws of the work of the central nervous system comprehensibly and apply them in piano playing.

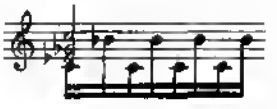
Most of these theories did not arise from practical achievements, nor were they verified by performing pianists. Their authors should simply be looked upon as belated followers of the finger and anatomic-physiological schools, sharing many fallacies of these schools, although sometimes making quite reasonable and modern-sounding contributions.

Quite apart stands Otto Ortmann, who published two books, *The Physical Basis of Piano Touch and Tone* (1925) and *The Physiological Mechanics of Piano Technique* (1929). The intended third part of his work—the psychological phases of the problem—was never finished; at least no results were published.

Ortmann's investigations were much more objective than those of his predecessors. In the first book he limited himself to the mechanics of the instrument; in the second, "to the mechanics of muscular action" with only "occasional excursions into the psychological field."[33] If the separate investigation of the instrument's mechanics is quite possible, the separation of the physiological (activity of bone-muscle apparatus) from the psychological (neural and cortical activity) is hardly so: "The acquisition of pianistic movements is primarily a psychological process,"[34] as Ortmann rightly states.

Ortmann made many important observations that helped expose the fallibility of some existing ideas in piano pedagogy. He said, for example: "Electrical stimulation has shown that, muscularly and mechanically, the normal infant is as ready to play a rapid five-finger sequence as is the trained adult; the difference is in the ability to tell the fingers in advance what to do; that is to say, the difference is one of experience, of learning."[35]

Unfortunately, Ortmann sometimes came to peculiar conclusions. For instance, since "any rapid movement requiring a quick change of direction is most economically made with a light body," he suggested that "the fingers can execute this [tremolo] much more easily than the heavier arm."[36] To prove this, the author brought up a completely abstract example:



In the entire piano literature we can hardly find anything similar. One can rotate the forearm much more easily and faster than he can work with isolated fingers; one simply has to make his arm as light as needed for the particular case.

THE PSYCHO-TECHNICAL SCHOOL

Certainly there was nothing completely new in the idea that the mind was important to technical development. More than a century earlier the pianist Ignaz Moscheles said that the mind should practice more than the fingers. Nikolai Rubinstein emphasized that a pianist would achieve technique, not by the amount of time spent in practicing, but by the quality of this labor, by the strength of will and attention directing the mind on musical problems. Hugo Riemann wrote: "It is impossible to develop velocity otherwise than through exercise of the telegraphic apparatus from brain to muscles. The process from within-outward cannot be replaced by anything."[37] Theodor Leschetizky used to say that intellect played the chief part in correct study; he recommended correcting mistakes mentally before playing a passage again.

But for the first time these ideas began to take a more significant place in theoretical works on piano playing. Such writers as Ferruccio Busoni, Willi Bardas, Grigori Prokofiev, Grigori Kogan and Egon Petri, sometimes breaking partly, sometimes more daringly and resolutely, with the principles of the dominating schools, groped for a way to develop piano technique on another basis. To

the names of these authors we can add those of great pianists such as Leopold Godowsky, Artur Schnabel and Walter Gieseking, who mainly in their performing and in their oral statements indicated new directions.

The finger school was represented by the teaching of practical men who were unable to keep pace with the changing times—changes in the instrument, new technical requirements put before the performer, new scientific achievements. The anatomic-physiological school was the teaching of theorists. Practical pianism refused to go along.

Today we have great pianists and great teachers (sometimes combined in one person) whose ideas are based partly on their own experience as performers and partly on their experience as pedagogues, who also take notice of contemporary scientific discoveries in the field of man's motor activity.

Ferruccio Busoni was the first to emphasize consistently the importance of mental factors in the pianist's practical work. He presented his ideas in his edition of the Bach *Well-Tempered Clavichord* (1894).

In 1910 Busoni wrote in "The Requirements Necessary for a Pianist": "Technique in the truer sense has its seat in the brain, and it is composed of geometry—an estimation of distances—and wise coordination."[38] Later (1917) he wrote: "The acquirement of a technique is nothing else than fitting a given difficulty to one's own capacities. That this will be furthered to a lesser extent through physical practicing and to a greater extent through keeping an eye on the task mentally is a truth which perhaps has not been obvious to every pianoforte pedagogue, but surely is obvious to every player who attains his aim through self-education and reflection."[39]

If the old school busied itself with indicating what to *do* and how to do it, now the question of how to *think*, how to *organize* the process of practicing and playing became of utmost importance.

The psycho-technical school believes that mechanical practicing is irrational and obsolete. Consciousness plays a great role in the process of the pianist's preparatory work, but this does not mean the conscious development of correct movements. The complex and fine process of innervation, relaxation and contraction of muscles, the degree of this contraction, the regulation of spatial relationship between parts of our playing apparatus—all these and many other processes take their course without participation of consciousness. Despite this fact, our motor activity flows faultlessly and highly reliably. Although the interference of consciousness in some of these processes is possible and sometimes desirable in the preparatory period, in performance this interference would be detrimental to motor activity.

Fortunately, we are able indirectly to influence, regulate and even improve these processes through concentrating on the *purpose* of our motor activity. In this way the conscious mind can influence the subconscious.

Exercise is a psycho-physiological process. Successful practicing depends on the clarity of our mental conception of a musical purpose, on the ability to concentrate attention and direct energy toward the attainment of this goal.

Representatives of the psycho-technical school are less concerned with abstract finger agility than with the musical substance of the piece being performed. Since the pianist's real problems are musical rather than technical, Busoni suggests that, until the musical meaning becomes clear, one should not touch the instrument. Because the demands of the keyboard tend to force one to forget about musical meaning, mental practicing away from the instrument plays an important part in the preparatory work.

Dexterity develops through musical awareness. Inexpedient movements are not the cause of technical deficiency, but one of its symptoms. To know the sense and purpose of a movement is the first condition for its natural flow. Consequently, technical practice should always be joined with musical practice, with study of interpretation.

Each difficult technical problem should be examined and approached from different points of view. Each time an intricate passage is repeated, its execution demands a new adaptation, and so acquiring technique appears as adjustment. Repetition, instead of dull drilling, now becomes a trial solution, a trial always rationally prepared. "If you had to open the door and had the wrong key it would only spoil the lock and the key if you tried it a hundred times. . . . Try different keys until you find one which fits,"[40] said Egon Petri.

Often the difficulty does not lie in the motor process itself, but is hidden in the musical demands. Problems can be caused by complicated rhythms in one hand or in polyrhythm, in coordinating the hands, irregular divisions of the meter, accents falling on inconvenient fingers, prescribed dynamics, complex or incomplete harmonies (two-part polyphony), sudden modulations or unusual progressions, as in atonal music.

The muscle sensation connected empirically with purposeful movement is much more important for technical development than the perception of movement form. Virtuosity is achieved, not because of pre-established knowledge of the forms of movements, but thanks to the practiced ability to anticipate the movement suitable to each given case and convenient for each individual. And until there is a connection between the inner musical imagination, the innervation of movement, muscular sensations, and careful and critical listening to the results, no form of movement is of practical value.

The psycho-technical school advocates the free and complete use of all parts of the pianist's apparatus, beginning at the fingertips and including the torso. This technique is universal, or in other words, the really *natural* technique of coordination. Countless combinations of

weight, swing and muscular force (energy) are possible: a pianist has to find combinations which answer his musical purpose and technical convenience.

Now at last the artificially created conflict between fingers and arm is eliminated. But the question of movement itself is not as important for the psycho-technical school as it was for the anatomic-physiological school.

Anatomic differences do not play so determinative a role in piano playing as was formerly believed. There were great virtuosos with various types of hands: Josef Hofmann complained that his hand was small, rigid and poorly stretched; Leopold Godowsky had a small hand and had trouble developing octave technique.

Any normal bone-muscle apparatus is sufficient for the development of a high degree of technique because of the brain behind the hands. The brain decides from an endless variety of possibilities what position to assume, what movement to execute.

Heinrich Neuhaus, teacher of Svyatoslav Richter, Emil Gilels and many other outstanding Russian pianists, reminds us of Michelangelo's simple expression of this idea: *"la mano che obbedisce all' intelletto"* ("the hand which obeys the intellect"). Neuhaus uses this quotation to explain that the clearer one's aims, the clearer one sees how to accomplish them.

Following Steinhausen's motto that we cannot teach our body how to move, the psycho-technical school suggests that the more our consciousness is diverted from the movement, and the stronger it is concentrated on the *purpose* of this movement, the more vividly do artistic idea and tonal conception persist in the mind. Consequently, the artistic conception creates a desire for its realization, the will-impulse occasioned thereby becomes more energetic, the needed natural movement is found more easily, and the process of its automatization is accomplished sooner.

Listening to great pianists not only miraculously influences a pupil's musicianship but his motor sphere as well. The teacher's artistic demonstration of some spot in which the pupil has failed often immediately helps to overcome the technical difficulty because it makes the musical image more vivid and clear. The method in which the teacher occasionally acts the part of an orchestra conductor, leading the student and showing him his artistic ideas, is very effective. It enhances the pupil's enthusiasm, heightens his will-impulse and keeps him from being too conscious of his physical movements.

Grigori Kogan in his lectures and later (1958) in his small book *U vrat masterstva* ("At the Gates of Mastery") put forward as psychological prerequisites of successful pianistic work three basic principles: (1) The ability to hear inwardly the musical composition which has to be realized on the instrument—to hear it extremely clearly as a whole, as well as exact in all its details. (2) The most passionate and persistently intense desire to realize that glowing musical image. (3) The full concentration of one's whole being on his task in everyday practice as well as on the concert stage.

Although the psycho-technical school holds that piano pedagogy must be built on an objective scientific foundation, it recognizes the great role that a teacher should play in the pedagogical process. The teacher's knowledge, his experience and talent are of the greatest importance, since piano pedagogy is an art, even when it is established on a scientific basis.

It is not surprising that representatives of the psycho-technical school talk little, if ever, about technique. They direct their main attention to the development of the pupil's musicianship, not to the development of his mechanism. They discuss music. They demonstrate their artistic ideas at the instrument, trying in this way to inspire their students.

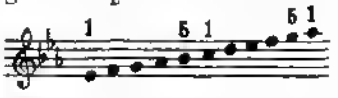
The young Franz Liszt suggested to a pupil an exercise that involved holding four keys down and striking strongly with each finger in turn, to make the fingers become completely equal. To avoid boredom, he advised reading a book or newspaper. But the old Liszt in his maturity spoke very little or not at all about technical questions. It is well known how disappointed his pupils were when they came to Weimar from afar, hoping that Liszt would reveal to them the secrets of his technique. *"Aus dem Geiste schaffe dir Technik, nicht aus der Mechanik"* ("Create your technique from your own inspiration, not from mechanics"),[41] so Liszt used to say in his later years.

This was also the teaching method of Leopold Godowsky and other artist-teachers. Artur Schnabel, who in earlier years of his teaching paid much attention to purely technical problems of his students, said later that "the role of a teacher is to open doors, and not to push the pupil through."[42]

The extreme point in this direction seems to have been reached by Luigi Bonpensiere. His Ideo-Kinetics require an intense concentration upon the musical end result, which must be strongly willed, and complete unconcern about physical execution. One has to "imagine the act as if already performed—and lo! it is done."[43] Bonpensiere insisted that for piano playing, musical preparation alone is required: "All exercises should be for the training of the mind alone."[44]... *"Never think of your music in terms of execution (of what your hands and fingers should or are going to do) but in terms of interpretative rendering (what you would expect it to sound like if a performer from heaven were executing it for you)."*[45] He added that there must be no doubt about success!

Ideo-Kinesis is not completely new to the world of music, but Bonpensiere carried it to the point of absurdity. The application of his system presupposes a spiritual attitude taught by Zen Buddhism, a doctrine with which Bonpensiere was evidently rather superficially acquainted.

The most unfortunate aspect of Bonpensiere's idea is to replace notes with symbols, since the notes themselves are symbols already. "Of course you cannot help hearing the sounds you are producing, even while you think of the symbol."[46] Fortunately so, because of course one always has to hear.

In many instances, Bonpensiere *just did not know*, for example: (1) Scale fingerings using five-finger positions throughout were advocated long before (by Busoni—also, partially, by Liszt). He sought to surprise his reader with this as his own new idea: 

(2) Practicing with one hand alone *does not always* benefit the other. Physiologists explain the functional relationship between the hands quite differently. (3) To bring out any desired tone in a chord is a rather easy procedure and does not "require an incredible amount of effort for action and control."[47]

Some statements of the psycho-technical school about the development of piano technique reveal certain misconceptions. It is impossible to build a scientifically proved, objective system of technical development if one relies upon vague speculations in the psychology of piano technique. With such an approach, more often than not, we would be turned from the right path.

The French scientist Jules Amar wrote that pianistic talent lies specifically in the domain of fast movements. True, the presence of a precise and intense musical idea helps immensely in the development of motor skill. And richness of imagination in the last analysis determines the greatness and diversity of the pianist's technique. But musical talent is not always necessarily combined with specific talent in the domain of fast movements.

To believe that there are only musical, no technical difficulties; that "our hands, with utmost faithfulness and without the least conscious effort, can reproduce the most elusive and complicated products of our musical volition"[48] is naïve. Every piano teacher encounters many musically gifted pupils who have certain difficulties, often not minor, in the development of their manual dexterity. And we very often witness performers who have excellent manual dexterity but whose artistic-musical development and imagination are (and, alas, will stay) on a rather low level.

The artist-teacher is very good for the greatly talented and advanced student who has already achieved a high level of musical and technical development. Such a teacher teaches music in the general sense but not piano technique; while showing a goal, he does not show the way to achieve this goal. This is left to the student.

For the pupil who is not a genius and who has not yet achieved a high level of proficiency, the shortest reliable path leads through understanding and conscious working out of those motor elements which are open to our understanding. The outward appearance of movement, position and interrelation of the parts of the playing apparatus—connected of course with the inner muscular sensation and the tonal result of movement—serve as a good, healthy foundation for the development of piano technique.

In the domain of pure technique, detailed and careful help of a knowledgeable and experienced teacher is most often imperative. Why force a pupil to discover what has been discovered before, letting him waste time and making his work, already difficult enough, still more difficult? How bright and strong his musical idea must be to cause his playing apparatus to find the needed adjustment easily and quickly! During the search for that adjustment, and working it out, the musical purpose, the artistic image can fade and grow dim and eventually become distorted. The trial-and-error method is time-consuming and inefficient. It should be replaced by inductive reasoning and insight with the careful testing of hypotheses that is typical of scientific procedure.

For two hundred years pedagogical thought looked to the pianist's playing apparatus—to muscle work, to positions and movements of arms, hands and fingers—for the solution of all technical problems. While the psycho-technical school offered a new approach, this was still not entirely scientific.

As we have seen, more than eighty years ago Emil Du Bois-Reymond stated that exercise in composite movement is really exercise of the central nervous system. Later, at the beginning of this century, Friedrich Steinhausen contributed much to this thesis.

Recently (1955) we read: "The modification produced by training is a modification of brain function"; and, "When a man learns, through long practice, to aim and to shoot a gun accurately, he has not trained the eye or the finger—he has altered the brain processes in such a way that his movements are more precisely related to the visual stimulation."[49]

It is evident, then, that the main attention of thoughtful pianists and piano teachers should be directed to questions connected with the activity of the central nervous system. The roots of technique are in our central nervous system. The problems connected with muscular conditions and outward appearance of our playing apparatus are important, but they are secondary.

PART TWO

The Central Nervous System and Piano Playing

CHAPTER FOUR

Structure and Function of the Central Nervous System

The human brain contains many billions of nerve cells which are connected with each other through nerve fibers. Owing to these connections, all nervous elements of the brain influence one another. Our behavior depends on this interaction of nerve cell units.

In all parts of the nervous system there is a tendency to differentiation, to specialization of function. The cerebral cortex (a later development of the brain in the scale of evolution) is divided into several parts which are separated from one another but interconnected. There are the motor and sensory areas, with visual, auditory, tactile and other subdivisions. Possibly there is a "free space"—a great number of cells ready to receive new impressions, create new connections and store them (memory). Moreover, some points which are already involved in a definite activity can change their physiological role and become connected with some other activity of the organism. The cerebral cortex has been likened to an extremely complex switchboard.

The constant reaction of the organism to external influences is effected through the nervous system. This process, although incompletely understood, is electrochemical in essence and consists of series of nerve impulses. The sensory (afferent) nerve fibers conduct specific impulses to the central nervous system from the parts of the body which receive external stimulation. From the central nervous system the orders for motor activity (reaction) are transmitted along motor (efferent) nerve fibers to definite peripheral organs. In this way the nervous centers receive and interpret external sensations (stimuli) and control all movements.

The simplest motor acts are involuntary movements in response to stimuli acting upon our senses. They are realized through the motor centers of the spinal cord and are executed without participation of the cerebral cortex. But they can, and do, become indispensable ingredients of the compound, more complicated movements in which conscious and subconscious elements interweave in diverse and constantly fluctuating proportions. These proportions are different for each individual and in each separate case.

Many seemingly simple acts, such as walking, running, grasping, climbing and eating are in fact very complicated performances. When we are walking, running or making movements with our arms, hands or fingers, our brain is receiving extremely rich and fine information from the periphery. This includes tactile sensations and sensations of muscular contraction and relaxation, all the sensations from position and constantly and instantly changing relationships among the participating parts of our body. Also included are visual and sometimes auditory impressions, and sensory impulses from the semicircular canals of the middle ear. This information gives the central nervous system the ability to organize, through motor nerve impulses, the perfect coordination of a great number of muscles—the relaxation of some, the contraction of others—in exactly the needed degree and at the needed moment.

We do not know much about the countless operations we have to perform in consciously directed and, usually, unconsciously realized action. And because we do not have to take care of the details involved in the performance of those seemingly simple acts, our movements flow smoothly and easily. At the same time our mind can be devoted to something (thoughts, conversation) which itself requires full attention and has no relation to the physical activity being performed.

Our motor activity at the piano has to be directed by the activity of our mind devoted exclusively to contemplating the musical progression, almost simultaneously, first in imagination, then after realization, as actual sonority that must be carefully controlled.

In very complex voluntary motor activity our consciousness plays a quite specific role. We are not conscious of *how* we function but are concerned with the *purpose* of our action. To the cortex, which actuates the motor apparatus as a whole, belongs the initiative and purpose, general design, strength and energy of a movement, and the control over its realization. The other constituents of the motor process do not depend directly on the cortex. The motor impulses from the cortex go first to the subcortical centers of the midbrain and cerebellum, the so-called extrapyramidal system. On these centers depend: preliminary setting of the muscle system for the beginning of each new movement; innervation of muscles and degree of their tension; sequence, rhythm, smoothness and swiftness of movement. The spatial and temporal regulation of movement forms depends on the fine collaboration of the cortex with sub-cortical centers.

The activity of the extrapyramidal system takes its course as a rule without the participation of consciousness, although the interference of consciousness is possible and very often indispensable during the process of *practicing* the piano. When something in the motor process is going wrong, consciousness can help in getting this process into working order. Some elements of extrapyramidal activity could, and should, be raised to a conscious level. After their conscious elaboration, these elements should then be returned to subconsciousness. But the direct interference of consciousness in the motor process while *playing* the piano would be detrimental or, at least, hampering.

Although it is impossible to determine precisely the bounds of consciousness and subconsciousness, piano playing can be said to consist of both conscious (purposeful, volitional) and automatized ingredients. The greater the share allotted to the automatized elements, the more natural, economical, adroit and precise the movement becomes. On the other hand, no matter how perfect the operation of the extrapyramidal system, its ability to adjust to the ever-changing external conditions is limited.

But between the primary motor elements (motor cells of the spinal cord) and the thinking part of the brain (the cortex) new direct connections are created. These connections help to subject comparatively primitive acts, performed by the lower divisions of the central nervous system, to the highest center. Thus the activity of these lower centers is modified and perfected.

When forced to new multiform adjustments, the motor activity of those lower divisions is overburdened with unnecessary concomitant movements and muscle overtensions. And often at first it does not accomplish a given task expeditiously. Externally this is expressed in awkwardness and clumsiness. But gradually the cortex *learns* to master the subordinated mechanisms, to reorganize their work. It adds purposefulness to motor acts: regulated by the highest centers, motor activity now becomes "thinkingly directed," skillful and graceful in appearance, and also more flexible. As a consequence, muscles have to perform their activity in somewhat different ways. Their contractions arise rapidly, last a very short time, and constantly interchange with relaxations. The motor apparatus now has much more to do. It seems to serve more masters now, to serve many new incoming demands.

Man is not born with a perfected nervous system. This develops gradually in the course of the first two years of life. In the early period of the child's activity, the components of uncouth, undifferentiated mechanisms are prevalent and clearly demonstrated. See the child try to grasp a small object by using his whole hand with all five fingers—the inborn grasping reflex. When he first uses eating tools—spoon, fork, knife—the child holds them with his fist. Later, how awkwardly he holds a pencil! Motor centers of his cortex still cannot project the exact movement necessary. With the development of his nervous system, the inborn motor mechanisms will be modified, mastered by the higher centers, and the child will be equipped for more purposefully differentiated action.

It frequently happens that even the pianist with some experience, as well as the beginner, is unable to achieve complete relaxation of his arms. When he wants his arm to fall down of its own weight, the extrapyramidal complex interferes instantly and prevents free fall. This physiological law of balancing our body and extremities in space is accomplished automatically by the cerebellum and is present constantly when the arm is in a horizontal position, as in piano playing. When the pupil's attention is concentrated mainly on his finger activity, the amount of normal tension necessary for that balancing can be exceeded, resulting in muscle overexertion. Thus the teacher, in trying to free his pupil's hand from excessive tension, is fighting against extrapyramidal mechanisms. Balancing of the forearm horizontal position must be done with the help of the motor mechanism of the cortex, which initiates graduated muscle contraction quickly in accordance with requirements.

By constant training we strive to achieve the maximal prevalence of the cortex over all lower motor centers. We learn by experience and thus heighten the efficiency and mobility of elements of the higher centers. To be successful this learning by experience must be knowledgeable. In the process of the technical development of a pianist we can witness the gradual forcing out of the old coordinated relations by new ones.

Careful control over sensations arising during movements (though not the detailed control dreamed of by the anatomic-physiological school) helps to exclude unnecessary exertions. If the higher centers do not prevail, the lower ones act independently, and the organized coordination is disarranged, the precision and smooth velocity of movement are disturbed.

INBORN AND CONDITIONED REFLEXES

All the natural reactions of the organism determined by the response of the central nervous system to external or internal stimulations are called reflexes.

The unconditioned reflex is an inborn permanent connection between an external stimulus and the organism's reaction to it. A classical example is the food-salivary reflex, produced when food is in the mouth.

When any neutral (or indifferent) stimulus repeatedly coincides in time with another stimulus which produces a definite unconditioned reflex, it becomes a signal and itself evokes the same reflex. If, for instance, the sound of a bell is repeatedly accompanied by the presentation of food, as in the case of Pavlov's famous experiment with dogs, eventually the sound of the bell becomes converted into a stimulus arousing the same salivary reaction in the dogs as food, although no food is presented. Reflexes created in this way are called "conditioned," because definite conditions are required for their formation, and their action also depends on numerous conditions.

The intensity of any reflex depends directly on the state of excitability of the reflex center, which in turn always depends on the physical and chemical properties of the blood. It is affected by fatigue, interaction of various reflexes acquired by previous experience, and by numerous extraneous stimuli and components of the given situation. All these can increase or decrease the excitation of the centers concerned, aiding or upsetting the formation of a conditioned reflex.

Being extremely fragile and highly sensitive, the conditioned reflex depends much more than the unconditioned reflex on the state of an organism—its health and the circumstances surrounding it. Under the influence of unfavorable factors, a conditioned reflex can weaken and finally disappear for a more or less long time.

THE SECOND SIGNALING SYSTEM

Stimuli which come directly to our receptors (visual, auditory, etc.) as impressions, sensations and notions of the natural world around us constitute the first system of signals of reality.

Verbal symbolism (signal of signals) constitutes the second signaling system. A word pronounced and heard, written and seen, or thought, when connected with any stimulus, can signal and replace this stimulus. It can become a real conditional stimulus and call forth all the reactions of the organism which are conditioned by this stimulus.

We are able to perform new movements on the basis of demonstration and description (second signaling system). This means that we can recreate motor acts on the basis of reaction to the old motor impressions and motor ideas imprinted in our memory. In a similar way we can create completely new forms of motor complexes through stimulation by signals.

As words turn into signals of the objects which they designate, so in music printed note signs become signals of sound. Written music is a graphic designation of tone combinations, representing a long chain of stimuli which constitute the second signaling system. In the case of a simple melody line we have comparatively simple stimulations. When the texture is more dense, as in many-part polyphony, or presents some intricate harmonic aggregations, we deal with manifold stimulations, which are sometimes extremely complex. These stimuli, which first excite the cells of the visual region of the cortex, are transmitted to the auditory region, and only then (normally) provoke the corresponding motor response.

The definite melodic design of the notes on a sheet of music creates in a musician the anticipation of an appropriate movement. It is interesting to watch a child with little experience in piano playing when he is asked to tap the rhythm pattern of an unknown musical composition that he is seeing for the first time. While tapping, he will move his hand in the direction of the melodic design: when the melody goes up he will move his hand to the right; when the melody goes down he will move it to the left. This is a demonstration of the reflexes connected by the visual-auditory stimuli or, in other words, the established motor reaction to definite symbols.

Signals of tones and their combinations as stimuli need not actually be seen in order to provoke the conditioned response. They can be thought, and that is what takes place when we play from memory. In playing from memory we have a combination of many stimuli acting upon pertinent areas of our cortex—visual (inwardly seeing the memorized printed notes or keys in patterned succession, or both) and auditory (inwardly hearing the succession of tones and their vertical combinations as well)—through the second signaling system. The intellect with the help of abstract thinking retraces the unfolding of the musical image by perception, elaborate analysis and synthesis of formal construction.

Thanks to practicing, the stimulated cells of the auditory area of the cortex become physiologically connected with the cells of the motor area, producing a chain of motor responses. It is of extreme importance that from the very beginning of music study this connection be established thus: visual—auditory—motor, instead of, as usually happens, visual—motor. The motor response should not be a direct reaction to visual stimulation. The latter should go through the auditory center and only then provoke the motor response.

A child usually starts his music lessons when many of his conditioned reflexes and differentiations of the first signaling system are already formed. His reactions to the second signaling system are developed to a certain degree (speech, writing), and his nervous system is prepared for adoption and assimilation of more complex connections and combinations.

ANALYSIS AND SYNTHESIS

In order to maintain an equilibrium with the surrounding world, our organism has to react in a definite way to the numerous stimuli which the senses perceive. Stimuli which are constantly acting upon our nervous system and exciting it must be analyzed within the organism so that it can respond properly. This function is performed by a special complex nervous mechanism called the analyzing apparatus. The task of this mechanism is to break up incoming stimulations into very fine, separate, quantitatively and qualitatively different elements.

The analyzer plays a role which can be compared with that of a prism, which decomposes white light into its elementary colors. So, for instance, our ear analyzers divide tones according to length, amplitude and form of their waves.

Besides the analyzers which deal with external phenomena of the outer world, there are special internal analyzers whose task is to analyze the immense complexity of inner stimulations. One of these is the analyzer of sensations from movements of parts of our body.

The phenomenon of analytical process is indissolubly bound up with the phenomenon of synthesis (the integrative function). This takes its course in the nervous centers together with the analytical process, and in the end it determines the perfect equilibration of the organism with the external environment. Only after the decomposed elements are combined into new aggregations are orders for reaction passed on to the executive effector cells of the central nervous system. From there the efferent nerve fibers conduct the orders for movement—the nerve impulses—to the muscles. In this way a stimulus is transformed into a motor reaction, a movement.

The entire route traveled by the nerve impulse from peripheral receptor through the transmitting afferent nerve fibers to the brain, and outward through efferent nerve fibers extending to certain executive organs, is called the reflex arc. Training establishes a conditioned reflex arc by repeatedly connecting any given sensory stimulation with a particular motor activity.

PROPRIOCEPTION

The nerve cells of the various sensory areas of the cortex are located in the same order as the nerve cells in the corresponding perceiving elements. It is as if we had a map of our senses on the surface of our brain. The auditory region of the cortex is a projection of the auditory organs; the visual region is a projection of the retina. The tactile-sensory area, being a projection of the skin surface, perceives all tactile sensations from the periphery of the body.

The motor area of the cortex appears to be a projection of the motor apparatus. Each muscle, tendon, joint, ligament has its representatives in the motor area of the cortex. Posture, spatial relationships, passive and active movements of separate parts of the body, various degrees of contraction and relaxation of the muscles and conditions of their accessory tendons, joints, blood vessels. . . . Sensations from all of these, intensified by tactile sensations, are sent along afferent nerves from the peripheral elements to the corresponding group of receptor nerve cells in the cerebral cortex and cerebellum.

These cells perceive, analyze and synthesize all incoming stimulations from movements and pass back to the periphery the signals to continue, to change, or to stop motor activity. Each movement, conscious as well as unconscious, effected by the motor impulse is immediately reported back to the motor region of the brain and recorded there. In this way higher centers are kept in constant touch with all the motor activity of the peripheral apparatus. Sensations from movements of parts of our body which are conveyed to our central nervous system are called "proprioceptive" (self-perceiving), as opposed to "exteroceptive" (tactile) sensations.

Proprioceptive sensations and our whole experience with these sensations in the past are of extreme importance for the direction of movements and degree of energy put into them, as well as for the construction and mastery of new movements. True, reason (purpose) initiates, maintains and guides effort toward acquiring a new motor act. But it would be impossible to learn a new movement by visual observation, verbal explanation and deliberation only, without previous motor experience.

For instance, when we walk upstairs or downstairs, our movements are directed by the visual estimation of distance (height of steps) and the necessary muscular coordination based on proprioceptive sensations. The richer our proprioceptive experience, the more precise is our estimation of distance and the more perfect the adjustment of our motor activity.

Proprioceptive sensations and the ability to make the finest inner analysis and synthesis of these sensations are necessary for acquiring motor skill. These motor signals also represent the only material through which our motor centers operate, the basis on which dexterous motor acts are built and developed. Hence, when aiming for the most efficient piano practicing, we have to take care that our proprioceptive sensations are clear and distinct. Slow playing serves this aim to some extent.

While practicing, slight exaggeration of movements will be of benefit in providing more vivid proprioceptive material, which must be as if imprinted in the corresponding cells of our brain. The contours of this imprint have to be precise and distinct. For better results these sensations should be consciously perceived. So movements in piano *practicing* differ, sometimes considerably, from those in piano *playing*. In the first case we have to consider not only artistic purpose but physiological points as well.

All this refers mainly to finger technique, the kind of technique requiring more time and more attention in its development than technique of the upper parts of the arm.

Here we come to the controversial century-old question: Should fingers be raised while practicing, and if so, how high? We know the prescription of the old school that fingers must be raised as high as possible. We also know that some piano teachers (and not only in recent times) have recommended never raising the fingers.

From the physiological point of view the answer seems to be that, while practicing, fingers should be raised to obtain the most distinct sensations from their action, but only as much as is needed for this purpose. As a rule, the first joint of the finger should never be raised higher than the back of the palm: higher raising would cause overstrain of the muscles concerned. What is important is strong, *active* finger work, since we receive much weaker sensations from weak movements than from strong ones.

A slight pressure into the key after its full depression is recommended in slow practicing. Tactile sensations as well as sensations from finger muscle contractions will be strengthened in this way. Some piano teachers of the past attributed special significance to the fine sensations in the fingertips, although they were not aware of the physiological value of these sensations.

Practicing legato passages with staccato touch will "engrave more firmly on your memory the order in which the notes (and the fingers which produce those notes) follow each other."[50] It will also sharpen proprioceptive sensations from the more distinct activity of fingers. This practicing must be finger staccato as distinct from hand staccato or forearm staccato. Soft playing should prevail, since in forte the unavoidable participation of upper parts of the playing apparatus (big muscles) would overshadow finer finger sensations.

Therefore, among several varieties of practice for finger articulation, the following is one of the best: first, fingers are prepared on the keys to be pressed. Each finger then presses with a light downward movement only, never leaving its key. (Thus the size of finger movement is equal to the depth of the key.) And playing proceeds very slowly, pianissimo, with the whole attention concentrated on fingertips. The downward movement of one finger must be synchronized with the movement of the preceding finger as it lets its key rise. At the slightest sensation of fatigue in the upper parts of the arm, this practicing should be stopped. (It is rather hard to hold the weight of the forearm without support.) By experimenting, the proper balance will be found, so that longer sections and eventually a whole study or piece can be played in this way. Such practicing is tiring to our central nervous system, as it requires finest tonal control along with control over the accompanying sensations, and this is especially hard in pianissimo. But the consequence of such practicing is a feeling of strength in the fingers. This result would be surprising to the representatives of the old finger school. Of course it is not muscle, but nerve command over the fingers that is being strengthened!

EXCITATION AND INHIBITION OF NERVOUS PROCESSES

Excitation and inhibition, the fundamental processes of nervous activity, are of equal importance. To respond instantly to ever-fluctuating and often abruptly and powerfully changing surroundings, these processes must be very flexible, able to adjust their mutual balance suddenly.

When a stimulus creates excitation, the result is a discharge of impulses. Inhibition suppresses superfluous (or even harmful) excitation. The restraining, coordinating and protective role of inhibition is of utmost importance in the integrative activity of the central nervous system, particularly in its highest divisions.

The behavior of an individual depends on the balance of excitation and inhibition. This behavior is determined by innate properties of the nervous system, one of which is extraordinary adaptability. Because of this extreme adaptability, the organism can modify its behavior influenced by the constant training to which it has been subjected from the day of its birth.

Since fast, even piano playing is the result of precise balance between these two basic processes of nervous activity, both processes require special training, particularly the inhibitory.

The excitatory process, first and basic in the formation of conditioned connections, is formed more quickly and easily and is more stable than the process of inhibition, which weakens easily and disappears under certain circumstances. As a result of this weakening of inhibition, muscle contractions are deprived of correct regulation: the frequency of incoming stimulations becomes higher than the ability of the neuro-muscular apparatus to recreate the repeated acts of excitation. Hence a change in the rhythm of excitation can occur. The fingers do not start to work at the precisely determined instant. They move out of time, and their muscles, after having finished the needed contraction, do not relax properly. Since one of the basic properties of the nervous system is to unite simultaneous as well as subsequent excitations in complexes, the described conditions tend to persist. The chain of movements appears to shrink: its links begin to overlap each other and playing becomes uneven. Carried further, this leads to complete overlapping of the links, to a tonic spasm, resulting in a complete block. Tendencies to accelerate the tempo, to rush at some spots, to uneven timing of finger activity are symptoms of weak inhibition and abnormal prevalence of excitation.

When the response to a stimulus represents a series of successive movements, then weak inhibition will fail to regulate a response that becomes abnormally vigorous, especially near the end of the series. A premature anticipatory response disturbs the progression to the final point. Slow and extremely even playing is indispensable, not only for obtaining clear proprioceptive sensations but for strengthening the inhibitory process.

But there are other more effective means for developing a healthy balance between excitation and inhibition. Since the disturbance of this balance shows itself most often in rushing toward the strong beat, toward the end of a passage, it would help train the inhibitory process to make stops or to retard (or both) *before* these points.

Stopping practice should be used not only to control what you just did and what you are going to do, but to force yourself to detain the impulse for the next movement for as long as you want at any given moment. This is an excellent means for strengthening inhibition. It is especially hard to stop before strong beats.

Rushing to the end-goal of a passage often happens in executing a trill. It is very useful to practice trills starting from the last metrical group. At first, play the last three or four notes (depending on the metrical division), then the last two groups, and so on, in combination with stops before each strong beat and especially before the final point.

When fingers become mixed up in executing a trill, a change of fingering often helps. It is more convenient to trill with fingers 1 and 3, or 2 and 4, than with 2 and 3: these fingerings facilitate forearm rotation, and it is easier to innervate nonadjacent fingers.

In connection with stopping practice, I suggest that at first the stops be for each beat, and later occur less and less often—one stop for every two, three and even four beats. Also, since the nervous system has a tendency toward fixation of any repeated pattern, its flexibility must be developed: stopping points should often be shifted.

Slow playing and also stopping practice are sometimes necessary even after mastering a piece or passage: what was achieved has to be preserved. There is a decrease in precision and freedom of the motor side of execution in the process of playing in fast tempo.

Regulating the timing of successive movements of the pianist's playing apparatus is one of the main problems in piano technique. Another is the regulation of tone volume. This ability must also be developed, and again the process of inhibition plays the main role in this regulation. We are familiar with the common occurrence of a student's playing in recital much louder than he intended. Because of weakening of the inhibitory process as a consequence of nervous excitement, he loses his ability to regulate dynamics in his playing.

For strengthening the inhibitory process, I recommend practicing pianissimo, extremely evenly, in slow as well as in faster tempos. The student should also be able to regulate both sudden and gradual increase or decrease in volume in any section of the composition and in any conceivable tempo. The ability to do this, plus the ability to slow down and to stop at any given moment, is the best proof of proper balance between excitatory and inhibitory processes.

IRRADIATION AND CONCENTRATION OF NERVOUS PROCESSES

The execution of a complex movement requires not only precise timing regulation but also involvement of the least muscle work needed for any given action. This is achieved by localizing the excitatory process.

After a conditioned response to a definite stimulus has been established, other stimulations of the same sensory field produce the same effect, although weaker. Suppose the original stimulus is reinforced (that is, repeatedly followed by an unconditional stimulus) while the other stimuli are not reinforced. Then the first stimulus will become more and more specialized, and the organism will now respond to that stimulus only (differentiation).

When excitation, as a result of some stimulation, arrives at certain cells in the brain, it is not confined to these cells but tends to spread (irradiate), involving other cells that are not directly related to this stimulation (generalization).

But excitation and inhibition are mutually connected processes, according to the principle of reciprocal induction (contrasting relation in which one process induces the opposite process). So the state of excitation appearing in a certain point of the cortex immediately calls forth an inhibitory process around the excited area. With practice, this area gradually becomes more and more narrow. This means that excitation is concentrated at the starting point, and inhibition is strengthened at the surrounding points.

Normally, every reflex act inhibits all activities unrelated to it. In this way the spread of original excitation becomes limited in space and is concentrated in certain points of the central nervous system.

The law of irradiation and subsequent concentration applies to both excitatory and inhibitory processes. It is of utmost significance in the elaboration of temporary connections, in forming conditioned reflexes.

Repeated application of the unconditional stimulus (movements of the playing apparatus) diminishes the extent of irradiation and helps to concentrate excitation. This will then affect only the concerned cells of the cortex's motor region. For best results this application should be carefully controlled: movements must be watched and unnecessary muscle contractions must be avoided.

According to the law of reciprocal induction, the stronger the excitation directed along a definite path, the

weaker its irradiation over the motor region of the cortex: strong excitation will be encircled by strong inhibition. This is what we experience when we concentrate our attention on the motor act being executed. We gradually rid ourselves of superfluous movements and unnecessary muscle contractions, achieve freer and more natural, smoother movements, finally performing them automatically. Physiologically, this means that the nervous act is now localized in the proper area.

This process of motor act concentration is demonstrated in the gradually increased ability to achieve differentiated, independent movements. First, this differentiation can be observed in muscle groups lying far from one another, as those of the right and left hands; later, in muscle groups of parts of one arm; eventually, in the independence of adjoining fingers.

Suppose we are performing a new motor act (that is, beginning to form a conditioned reflex). Then the nervous process taking its course the first time irradiates not only over the immediate surroundings of the stimulated center along the path of temporary connections. It also irradiates considerably through the motor centers of the cortex, exciting various points of this region. It is manifested in many unnecessary movements and needless muscle contractions.

A pupil executing a new and difficult motor act with one hand, at the same time overstrains the muscles of his other hand. Every piano teacher can often observe this phenomenon. The reason for difficulty in executing a trill is usually not the lack of capability of the fingers involved. Rather, owing to irradiation of excitation over a large part of the motor region, instead of differentiated motor activity—the needed stimulation of the proper motor cells only—the muscles of nonparticipating fingers are involuntarily involved and overstrained.

Every strong excitation, creating around itself an inhibitory process, hinders the simultaneous formation and normal flow of weaker excitatory processes in other parts of the cortex's motor region. Such antagonism occurs between the sensations from the work of large muscles in the upper parts of the arm and sensations from the work of small muscles in the fingers.

In piano playing the combined work of fingers and upper parts of the arm is a continual occurrence. Depending on the type of technical formation, there is at any given moment a prevalence of greater or lesser activity in this or that part of the playing apparatus. When this activity is predominantly concentrated in the upper parts of the arm, the sensations from movements of these parts (big muscles) overshadow the sensations from finger work (small muscles).

As we know, the main materials for the building of piano technique are the proprioceptive sensations. Hence lack of clearness in these sensations from finger activity will inevitably result in indistinct finger technique.

The harmful idea which the anatomic-physiological school brought to piano pedagogy, and hence to piano playing, was the concentration on the movements of the upper arm combined with passivity of the fingers.

Balancing and proper correlation of all parts of the playing apparatus is an extremely important problem and must always be the center of a pianist's attention. The more the upper parts of the arm are involved in executing of a composite movement, the more attention should be directed toward the *polishing* of finger proprioceptive sensations while practicing such a passage. That is why practicing with each hand separately, especially with the left hand from which we receive much weaker proprioceptive sensations, is important.

In the central nervous system, reciprocal relations exist between flexors (bending muscles) and extensors (straightening muscles). The intense excitation of flexors will call forth intense inhibition of extensors, and vice versa. Since the inhibitory process is weaker than the process of excitation, a slight raising of fingers (intense excitation of extensors) before their descent into the keys appears to be a valuable means for strengthening weak inhibition of flexors. The tendency to rush, to accelerate passages is observed mostly among students who are not used to raising their fingers while practicing. Now we see one more reason for the requirement of raising fingers in *slow practicing*.

The sensation of resiliency in piano playing is based on reciprocal relations between nervous processes. This question has always been controversial. The pianist clearly feels the elasticity of the hand while executing so-called wrist staccato as in light octaves, especially in repetition technique. This puzzled theorists of piano playing, who, quite rightly, could not find any elasticity either in the hand or in the piano key. But the hand really can "jump like a kettledrum stick" (Nikolai Rubinstein's comparison), a sensation that occurs according to the *physiological* law of reciprocal innervation, not according to the *physical* law of elasticity.

In fast repetition of the same movement, the flexors start to contract a little before the extensors relax, and vice versa. This creates resiliency and contributes to smoothness of movement.

ESTABLISHING STABLE CONDITIONED REFLEXES: THE REFLEX OF PURPOSE

The profound interest in a given subject and strong desire toward achievement of a definite goal are very important prerequisites for the successful formation of a conditioned reflex. We learn easier and retain better what seems interesting than what is dull.

Pavlov's followers tell us about a hypothetical focusing, orienting, investigating reflex which implies the condition of motivation and seems to be related to evoking a state

of alertness or attentiveness in the central nervous system. Called the reflex of purpose, it does not culminate in a definite external reaction. But elicited and strengthened by some circumstance (in our case, a strong desire directed toward realizing a vivid musical image on the piano), it expresses itself in functional change and increased excitability of the whole nervous system (a state of raised emotions, enthusiasm). The result is heightened activity of definite relevant nervous elements while other points of the central nervous system, due to the law of reciprocal induction, are in a greater or lesser degree inhibited.

The process of coupling two nervous points, of laying a new neural path, cannot take place if we are in a state of fatigue or drowsiness or if our mind is not free from irrelevant activity. Even when these hindrances are not too great to prevent the formation of a conditioned reflex completely, its formation will take much longer and will need a great number of repetitions. Clear, definite stimulation is absent. There will be extraneous motor activity and, finally, instability of the conditioned reflexes formed in this way.

The strictly simultaneous application of conditional and unconditional stimuli is not favorable for conditioned reflex formation. It is a fundamental prerequisite that the agent used as a conditional stimulus should always slightly precede the application of the unconditional stimulus. Thus the conditional stimulus will acquire the role of a signal, anticipating the physiological activity called forth by this signal.

If a definite motor activity has started before the application of a conditional stimulus (or simultaneously with it), the resulting strong excitation of motor cells will inhibit the rest of the cortex. Thus the cells which have to be affected by the conditional stimulus (say, the cells of the auditory field of the cortex) are in a state of inhibition and cannot acquire excitatory properties.

The same contiguity is required later: the proximity of conditional and reinforcing unconditional stimuli. The conditioned reflex already well established by the correct procedure gradually loses its positive action, if the conditional stimulus is constantly applied after the beginning of the motor activity, or is very weak in comparison with the strong stimulation of the motor cells. This strong concentration on the motor part would inhibit the corresponding cells of conditional stimulation, and the latter would thus be in a constant state of inhibition. In the absence of a strong direct incentive, the conditioned reflex will deteriorate and finally become ineffective.

When a stimulus upon which a conditioned reflex was successfully established is applied without reinforcement (that is, without subsequent application of the unconditional stimulus), the conditioned reflex diminishes markedly and, in the end, is apparently extinguished completely. After rest, though, with the help of an incentive this conditioned response will be recovered. The conditioned connection is only temporarily sidetracked by the process of "internal inhibition."

When a pianist realizes a given musical idea, the tonal image, the auditory stimulation (conditional stimulus), must always precede the motor reaction (unconditional stimulus), in performance as well as in practicing. The musical incentive has to be a signal provoking the motor activity. Otherwise the latter, the technique, can easily become an end in itself.

In the scheme **see → hear inwardly → move → hear actually → control**, the second link of this chain, being a conditional stimulus, will call forth the movement which produces the sound. This result is immediately checked by the attentive ear and evaluated. So, in circular fashion, this functional relationship is preserved all the time the pianist is active at his instrument.

When we memorize a musical composition away from the instrument and only later include unconditional stimulus (actual playing), the necessity for close temporal sequence of conditional and unconditional stimuli seems to be negated. But this is only an apparent negation. The process of silent memorizing, based exclusively on visual and auditory cognition when the symbolic representation of auditory stimulus (the musical score) is not connected with the anticipation of the corresponding motor activity, is, in fact, hardly possible. Exceptions are cases of eidetism (phenomenon of photographic memory).

The ability to memorize music without the reinforcement by immediate consequent motion is evidently based on the previously established symbolic stimulation–motor response connections. While reading a musical composition away from the keyboard, the pianist should have in his whole playing apparatus the anticipatory sensations of appropriate motor action for a real performance. Mental hearing must be connected with mental feeling.

The form of any new motor activity should be consciously perceived and perfected. Even under the best conceivable conditions of practice, a great amount of repetition is needed. Of course, these repetitions have little in common with those required by the old school. During one practice period, several conscious well-prepared repetitions of a troublesome spot in a piece can be sufficient. When we repeat that spot too many times, our attention is weakened and consequently distracted: unconscious repetition would probably obliterate the positive results we had achieved.

We should point out that pupils are often inclined to repeat a passage in fast succession, starting the next repetition when the preceding one is hardly finished. In correct practicing, a slight pause (several seconds) must be inserted between repetitions, to give the pianist time to check whether everything just performed was correct and the results were musically satisfactory, and to prepare himself mentally for the next repetition.

Conscious effort can help in organizing the process of practicing, and so facilitate the work and shorten the time needed for achieving the goal. But comprehension cannot replace necessary practicing. The necessary number of repetitions and length of period needed for assimilation of a new combination of movements depend on several circumstances. The most important are: (1) the complexity of a given motor form; (2) the type of nervous system of a given individual; (3) the concentration of his attention; (4) the previously established connections.

This last point represents the foundation upon which all subsequent learning is based. We have in our motor storage countless forms of motion which in later technical development we often use as half-ready products. These have to be selected and modified in accordance with some particular purpose. On the basis of retained experience and with the help of conscious and subconscious motor activity, we learn and gain proficiency in the most complex technical tasks.

It is evident that with the conquering of each new motor problem we add new motor forms to our experience, thus enriching it and making later formation of complex motor acts easier and easier. The more extensive the previous motor experience, the easier will be the required adaptation.

The ability to adapt to new situations also depends, to be sure, on the properties of the central nervous system. Yet it should be clear that those who start to learn earlier in life and whose development is guided by knowledge of pertinent facts and physiological laws will be better prepared to solve taxing problems in any new situation.

With age, the characteristics of the learning process change. Young children tend to careless repetitions following quickly one after the other. They have little or no patience; reflection is not their virtue, and the span of their attention is comparatively short. Tendency to adequate analysis, discrimination between right and wrong, caution, patience and effective organization of working processes develop with increasing age.

But all the shortcomings of the young in comparison with the maturity of older persons are compensated for by the flexibility of their central nervous systems. Conditioned reflexes are established easily; the subconscious process of choice in perfecting movements occurs naturally and spontaneously. In spite of the adult beginner's better perception of situations, logical comprehension and higher cognitive capability, he is physically awkward and has enormous difficulties in establishing conditioned reflexes.

Sometimes excessive industry and strenuous practicing can result in failure. The more persistently one tries, the worse the results. Fatigue of the central nervous system, which is not noticed by the player, is the reason for this failure. When in despair he abandons his efforts and later resumes his work, he notices that many, if not all, obstacles are miraculously gone. Fatigue is alleviated by rest. With a fresh start, the results of previous practicing show themselves clearly.

CHAPTER FIVE

Development of Motor Skill

An infant's movements are random, the result of general undifferentiated responses. Gradually, through his motor activity the child perceives distances and forms of objects. He connects proprioceptive sensations with visual sensations. And the visual stimulations become signals of needed movements.

The child wants to seize something. First it makes many chaotic, helpless grasping movements. When one of these movements happens to be positive and the goal is achieved, the sensation from the successful movement is connected with visual stimulation from the pursued object —its form, location and other features. Gradually, again after some "trial-and-check" procedure, the child begins to see more and more precisely, later responding with only the necessary movements on the basis of these visual stimulations.

Later in life reason and eye will become the most important guides in creating and mastering new motor acts —initiating, maintaining and directing effort, and selecting the appropriate form of movement. Yet the sensory-motor experience will always remain an indispensable ingredient.

The absence of sensory-motor experience in its special application to piano playing partly explains why it is so hard for an adult beginner to gain motor skill. This is true even though his intellect and ability for visual conception of movement form are more highly developed than a child's.

Each new form of movement is first visually projected on the basis of previous experience and development of visual-motor connections. The movement is performed according to the visual projection, producing those proprioceptive sensations from the motor act which become the material for construction of intricate motor complexes.

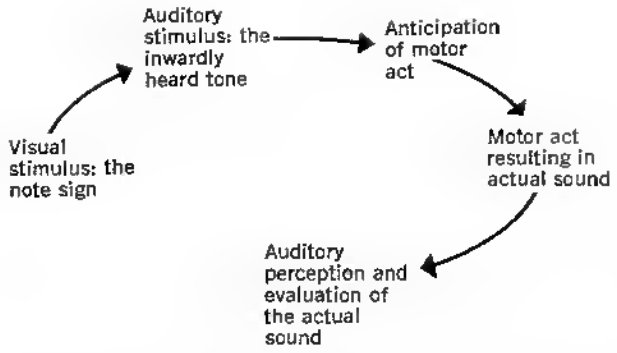
The beginner at piano, looking at the chosen key, visually projects movements of his arm and finger in order to reach this key. This stimulation is directed into the motor area of the cortex, whose cells activate the muscles that participate in the movement. This is experienced as anticipation of movement. The anticipation is far from exact: it does not coincide with actual conditions. The eye is still unable to calculate the dimension of the movement, the resistance of the key, and the tactile sensations resulting from pressing this key. When the player reaches the key and presses it, he receives proprioceptive sensations accompanying his motor action, which includes too much of the initial state of motor learning: superfluous muscle contractions and redundant movements.

Besides, according to the principle of generalization, those proprioceptive sensations expand over a large part of the motor region of the cortex and have rather vague contours. As this procedure is repeated many time in later practicing, the motor action changes its form, becomes unsteady and probably even worse than it was the first time. But gradually, under conscious ear control ("trial-and-check" approach), everything irrelevant is omitted and only purposeful movement is fixed by inhibition which encircles the excited centers of the motor region of the cortex. The guiding principle here is the evaluation of the *result* of the motor act—namely, the sound.

Usually, in traditional piano pedagogy the pupil, seeing the note sign, finds the corresponding key, presses it, and looks for the next note sign, next key and so on. The scheme is: **visual impression → search for a key → movement.** Alas, the result of this movement is very seldom heard. There is no time for listening: the next note must be found and played.

Rather, from the beginning the piano teacher should strive to establish and develop the following scheme: **auditory stimulus** (the inwardly heard tone) **→ anticipation of motor act → motor act resulting in actual sound → auditory perception and evaluation of the actual sound.**

Later, after learning note reading, the pupil will first have the **visual stimulation**—the note sign. This stimulation will be transmitted from the visual to the auditory area. And so we add one more link to our scheme, the link which now will be first.



In the initial period of study, the pupil should concentrate on tone production, starting from single, separate tones, with attention on tone quality, proprioceptive sensations and form of movement, all three closely united. Soon he should be given simple tunes to play by ear. At first the teacher plays sample tones as well as short tunes, and the pupil reproduces them by direct imitation. In a short time the pupil should hear inwardly without the teacher's playing first. Then transposition should be introduced to develop the ability to find a familiar tune starting on any key. Through transposition, auditory-motor connections are strengthened and, at the same time, made more flexible.

The introduction of note signs as symbols of things already experienced comes later. How much later depends on the individual pupil's capacity. When the visualized note sign is included as the first link in the chain (as shown above), the teacher's task is to watch carefully to see that the inwardly heard tone—now the second link—is not skipped, so that the connection between the first two links is strengthened.

The piano teacher must find a fine balance between the natural development of the movement, as described at the beginning of this chapter, and the cultivation of movement by reasoning—through understanding and regulating its most appropriate form, and through keen perception of the proprioceptive material. Along with this, he must make sure that the sense of hearing is always a leading and controlling element.

In subsequent years of continuing study, two aspects—the musical idea and the technical means for its realization—should go hand in hand. The musical idea, always going slightly ahead, should stimulate technical development. If technical aspects take the leading role, there is the danger of degradation into superficial virtuosity. How many pianists have fallen prey to this danger!

At the foundation of such a complicated activity as playing a musical instrument lies the formation of conditioned connections. When excitation of any one of the cells of the cortex's motor region coincides with the excitation of some other motor cell, or arises within a short time interval of it, a connection forms between these two elements. This means that after numerous repetitions of the simultaneous or successive excitation of these two cells, the excitation of one cell with subsequent activity of a certain muscle will immediately cause the excitation of the second cell and the activity of its corresponding muscle. The result is a *chain response* (chain conditioning).

Numerous uniform successive repetitions of this cycle result in partial substitution of internal stimuli for external ones: the proprioceptive sensation from one motor act becomes a stimulus for the next. Thus, these repetitions prepare and establish in the cortex new connections, resulting in a long chain of uninterruptedly flowing movements (the condensation of serial reactions). The action will now require the starting impulse, general control of *purposive* character, and attention of the perceptive ear.

The number of repetitions needed to establish these conditioned connections and for soldering many movements into one smoothly flowing line depends on the simplicity or complexity of the motor act being performed, mobility of nervous processes of the given individual, and, of course, his ability to practice with real concentration on the correct point. The player must receive a clear proprioceptive sensation from each movement, sensation which does not coalesce with the sensation from the next movement, and is not suppressed by it.

Practicing with deep legato, with each finger holding its key a fraction of a second after the next key is pressed (so the tones slightly overlap), is a very good way of forming conditioned connections. It provides stabilization at the joints of transmission of energy to the key (hand and wrist remain unmoved), and helps somewhat to isolate finger activity from the activity of the upper parts of the arm, especially when it is done very softly. A clear sensation from the movement of each finger calls forth the movement of the next finger, connecting these single movements into one complex motion pattern.

How strong the established connection can be is shown by a familiar occurrence. Consider the playing of a succession of definite intervals in one direction, a broken triad, for instance. If the player, through inaccurate estimation of distance, makes a lateral movement of a finger or upper part of his arm which is too far or not far enough, he will play a wrong note, higher or lower than intended. The next note, or, most probably, the whole sequence of successive notes, will be shifted higher or lower. This shifting is explained by the strongly established conditioned connections: miscalculation between two links of the chain does not disturb the fixed connections between the following links.

It is rather hard to correct this mistake while going on. To correct it in this case would mean to make another wrong (but corrective) movement, thus making up for the preceding lateral movement's being to far or too near. After making and correcting such a mistake or any other, one should repeat the section many times to get rid of the wrong conditioned connection and establish the right one.

CHAPTER SIX

Development of Velocity

The limit of speed of motion for each individual is the limit of mobility of his nervous processes—their ability to replace one another quickly. Intense processes in strong cells of the motor analyzers have greater mobility than weak processes in weak cells which arise and replace one another slowly.

The inborn type of central nervous system a person has determines the degree of initial mobility of his nervous processes. But the central nervous system is capable of almost limitless improvement under the influence of training. Contrary to what one might think, training the weaker inhibitory process which regulates movement is more important for the development of speed (and more difficult for the cortex) than training excitation.

In the rapid succession of movements, the same correlation between excitatory and inhibitory processes should be maintained as in slow tempo. This appears to be a most difficult task for our nervous system because, while increasing speed, we strengthen excitation and suppress inhibition. Therefore, the increase of tempo while studying a musical composition should proceed gradually, and this increase must often alternate with slow and very careful playing. The ability to play evenly and the ability to slow down at any point in a passage serve as criteria of precise and sufficient inhibition.

There are persons of inert and sluggish demeanor, usually physically weak, who do not achieve satisfactory speed in their movements in general and in piano playing in particular. Apparently, in their nervous systems inhibition overbalances excitation. But it is only a seeming overbalance. In fact, both processes are inert and weak. The weak inhibition remains too long in the nerve cells and is only slowly replaced by a weak excitatory process. It is the task of the teacher to strengthen both the inhibitory and the excitatory processes.

In such cases, it is important that all movements be executed energetically. It should be emphasized that slow playing does not necessarily mean slow motion. The movements must be swift but clearly separated from each other. Deep legato practicing is extremely useful for strengthening weak nervous processes. After-pressure of each finger is recommended.

But attention! Do not allow any overexertion of the participating muscles or involvement of unnecessary ones. The best control can be realized in the following way: while pressing a key rather strongly, try to move the wrist up and down smoothly and evenly, sensing its flexibility. *Combining strong finger grasp with a flexible wrist is one of the main problems of piano technique.* The teacher must strive to develop this ability in his pupils.

When the desired tempo increase proves difficult for the student with weak nervous processes, the following rhythmical variant is highly recommended: Divide the piece (or passage) into metrical groups, at first short, later embracing longer and longer stretches. Practice the passage with stops, this time *on* strong beats (compare with the contrasting suggestion, page 26). The aim is now somewhat different: whereas it was the development of inhibition in the former case, it is now the strengthening of nervous processes.

This recommended variant is of great use in all cases where we wish to increase tempo. It can be used when our peripheral apparatus is capable of fast execution, but when we still cannot *think fast* enough through the entire composition or, at least, through comparatively long sections of it. By "think fast" we mean the exceptionally rapid remaking (analyzing and synthesizing) of visual-auditory stimulations acting upon the nervous system, with quick reaction and unhampered transmission of the orders from centers to the executive apparatus.

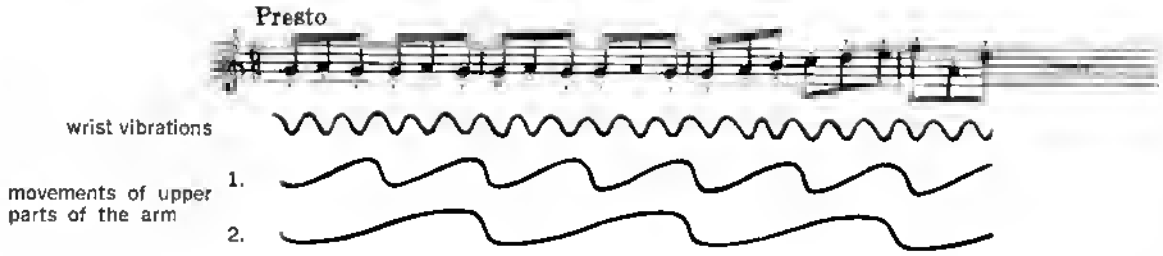
When discussing the ability of a pianist to develop speed, we have to add that speed in piano playing also requires ability to estimate distance. This often appears to be a decisive element. Especially is this true in the case of swift leaps. Here the experienced pianist can notice that if he hears inwardly the distant note, the leap most probably will be successful: the pitch analyzer stimulates the precise motor activity of his playing apparatus. Conditioned connections between points of auditory and motor areas of the cortex have been established during many years of playing. The inward perception of tonal distance dictates the exact dimension of lateral movement of the arm toward the proper key.

Mental control over arm movements, although much easier to achieve than control over fingers, is also of utmost importance. The participation of the upper parts of the arm in piano playing is constant; only the proportion of participation of various parts of the whole playing apparatus changes. "Nothing by fingers without arm, nothing by arm without fingers," Leonid Nikolaev, one of the great Russian piano teachers, used to say, negating the main principles of both the finger and anatomic-physiological schools.

Recent observations on the development of cyclic movement velocity show that the limit of frequency of wrist vibrations is achieved (seven to eight per second) around the age of thirteen. In the next several years further increase is almost imperceptible. But higher frequency of cyclic movements is connected with higher development of movement coordination.

The frequency of wrist vibration can be increased with the help of coordinated movements of the whole arm in connection with metrical division. One has to unite several vibrations in one metrical group and begin each group by dropping the whole arm with accent, then gradually raising it (including the wrist) toward the last note of the group. Thus he can start the next group again from the higher level with accent, and so forth. The faster one wants to play, the more vibrations he must unite in one group.

A good example is provided by Mendelssohn's Song Without Words in C Major, Op. 102, No. 3 where one could combine three wrist vibrations under one movement of the upper parts of the arm (Ex. 1). But to achieve greater velocity, one has to combine six in one group (Ex. 2), thus:



The nerve fibers, depending on their thickness (the thickest connect centers with the most distant parts of the body) can transmit messages by nerve impulses with a speed up to 450 feet per second. But as these impulses are slowed down at every synaptic junction, it takes from one-tenth of a second to about one second for tactile sensations to reach our consciousness. Evidently, the movements of our extremities are performed somewhat later than the orders for these movements are given in the central nervous system.

Consequently, the resulting sensations from voluntary movement can reach our consciousness only after nerve impulses travel a *double way:* from the center along efferent nerve fibers to the executive organs—arms, hands, fingers—and from there along afferent nerve fibers back to the cells of the cortex which perceive the peripheral signals.

But if our movement is purposeful, then other stages are included in the process just described. Several regions of our brain are involved in the action: visual, if we have visual incitement for the movement following, or auditory, if stimulation is arising in that region, or both. In the process of playing the piano from a score, the complex interconnection between visual, auditory and motor regions of the brain is obvious.

Of course, we have to take into consideration that the velocity of nerve impulses varies with every individual. And in the same individual it can change—be increased or decreased by interfering circumstances.

Pianistic talent—dexterity, fluency, precise estimation of distance, wise coordination—depends on the inborn and trained capacities of the central nervous system.

PART THREE

Problems of Piano Playing and Teaching

CHAPTER SEVEN

Esthetics and Technique

THEORY OF MOVEMENT

Method denotes that particular form of procedure in teaching which is supposed to lead to mastery, to maximum success in the shortest time and easiest way. In speaking of piano playing, some musicians have used the word "method" erroneously to denote what should properly be called theory of movement.

Evidently, method was once understood as frozen dogma and thus acquired a sort of derogatory connotation. Indeed, the expression "absence of method" was used in describing the attributes of a good piano teacher.

Certainly, every piano teacher should have his method, for absence of method in pedagogy means chaos. But the use of some definite method in piano pedagogy by no means excludes an individual approach to each student. Such an approach, which requires a certain flexibility, appears to be just one of the features of any true method in modern pedagogy.

One of the tasks of piano methodology is to bring esthetics and an appropriate theory of movement into teaching. Thus through theoretical and historical knowledge, broad experience in music in general and piano playing in particular, a student's musicianship will be developed. The theory of movement has to have as its foundation the latest achievements in the relevant branches of modern science.

There must be no narrow conception of hand position. The playing apparatus is in constant motion, and the traditional fundamental position—forearm almost horizontal and fingers slightly curved—should be considered as a point of departure only.

Adolf Kullak recognized this and wrote (1861) that the trained hand must understand the principle of low as well as of high position. Only then will it act with complete dexterity in the intermediate positions which are dictated by successions of tones and dynamic gradations.

We have to teach a beginner how he has to press a key and hold his hand on the keyboard. But then we immediately come to the problem of pianistic movements and have to discuss the laws of these movements. At the first attempt to widen and enrich his technique, our beginner will inevitably depart from the fundamental position. His motor activity will consist of a variety of movements of his hand and fingers, and the upper parts of his arm by which the hand is brought to various positions.

Without an elaborate theory of pianistic movement there can be no real teaching of piano playing. But it is impossible to describe the movements of a pianist's playing apparatus without live demonstration and without auditory perception of the resulting sonority. Even with live demonstration, a very important element is still elusive: the sensations arising in the playing apparatus. Here we have to resort to vague definitions, metaphorical explanations and comparisons.

Therefore, attempts to give a written account of a theory of movement have ended in failure, except where authors have confined themselves to a description of the most primitive movement forms. As a rule, representatives of the old finger school were fairly successful in these endeavors. In spite of their often incorrect statements, they were able to put down their ideas in a comprehensible way. Actually, it was fairly simple to write about "the unmoved hand" or "the power of highly lifted fingers," and a reader could understand what was meant.

But as soon as the whole arm was liberated and consciously involved in pianistic motor activity, writers were unable to give clear descriptions and explanations of the infinite number of external combinations and coordinations, and of the much more elusive internal occurrences. We remember Deppe's unfortunate expression "free fall" and the ambiguities we have seen in later writings of the anatomic-physiological school. Too, the unhappy description that Liszt played octaves as though he were shaking

them out of his sleeves may have led many young pianists astray.

The confusion can be ascribed partly to the lack of accurate terminology. A really fitting terminology in the domain of piano playing and teaching has not yet been worked out. This was one of the reasons why many great piano teachers did not want to leave a written account of their technical system.

The purpose of the third part of this book is not to make one more attempt to set forth a theory of movement nor to propose a method of piano teaching. Instead, its purpose is to consider and try to explain some relevant points.

INDIVIDUAL TECHNIQUE

Until comparatively recently, piano technique was considered as something independent from the art and personality of the performer. But technique is not an abstract, unalterable notion. Piano technique, in a broad sense, is the sum of all the means a performer has for realizing his purpose, his artistic musical idea. Therefore, piano technique cannot be looked upon as something independent from the music and from the personality of a performer.

"The tonal idea defines technique; from ear to movement, not vice versa," said Konstantin Igumnov, a great Russian piano teacher. Since the tonal idea is not an unalterable notion, and every musician has his own, it should be obvious that there are as many different piano techniques as there are different conceptions.

Teachers have searched for principles of a perfect technique identical for every pianist. But the history of pianism has left us no example of universal perfect technique. Differences in esthetics call forth differences in the technique of piano playing. While Anton Rubinstein tried to achieve singing tone and legato, Ferruccio Busoni believed that the nonlegato touch was closer to the nature of the piano, that it was erroneous to model instrumental technique after the rules of singing. Busoni's technique was molded in accordance with his esthetic ideas, that of Anton Rubinstein, in accordance with his.

Every creative artist has his individual technique suitable for the realization of his intentions. Furthermore, the really great pianist does not have *a* technique, but rather, *many* techniques. The musical ideas of each composer are expressed in a definite, individual manner. Hence the technique of a performer, his approach to tone production has to change, depending on whether he is playing Mozart or Bach, Beethoven or Debussy, the Chopin *Berceuse* or the Chopin Etude Op. 10, No. 1.

Technical perfection should be measured, not by the degree of a pianist's mastery over this or that form of technique, but by the correspondence between his artistic intentions and the means of their realization.

Anton Rubinstein, according to Rachmaninov, played the Finale of Chopin's B-flat minor Sonata so fast, soft and legatissimo that separate notes were not heard distinctly. With the help of the pedal, he produced some kind of continuous humming that left a striking impression which was hard to describe but could never be forgotten. When, in one of his New York concerts, Emil Gilels interpreted this Finale in the same way as Rubinstein had, one of the critics wrote that for a pianist of such technical proficiency the last movement sounded "strangely muddy." But of course he misunderstood: the sonority realized by Gilels was the highest achievement of a great pianist with rich imagination.

Yet, while consummate technique is individual, the basic laws of its development are common to all. All human beings are subject to the same physiological laws, all normal human bodies are built on identical principles: they have similar skeletal construction, muscle function, similarly working central nervous systems. They are at least similar to such a degree that it is possible to speak of common physiological laws governing motor activity—hence of the common prerequisites for building the foundation of a piano technique.

The acceptance of an objective, scientifically grounded outlook in the development of piano technique does not mean uniformity of piano playing. It does not imply that the pianist would be deprived of his individual means of expression.

In the first stage of a student's musical-technical development there is no place for individual technique. The student is more or less under the influence of his teacher, especially if the latter has a strong artistic personality. Therefore, his playing will express the musical ideas of his teacher, and he will use the corresponding technical means.

Gradually the student's own personality will start to show, and his technique will shape itself in the forms most suitable for the expression of his individual creative will. Then we have not only the possibility, but the necessity of modification and widening of the technical modes in accordance with individual requirements. It is one of the piano teacher's problems to help reveal the pupil's individuality, not suppress it, to help in gradually overcoming the unavoidable limitations of the initial period.

Usually, full self-expression of the completely independent artistic conception comes after the pianist's years of study are finished when he, as a mature master, is on his own.

TONE PRODUCTION

I will abstain from any particular discussion of tone production, for this defies abstract description and must be confirmed by live illustration and auditory perception.

But I do wish to call the reader's attention to some important questions concerning tone. The kind of movement (its form) and amount of energy exerted for producing this or that quality of tone are of secondary consideration. The quality of a pianist's tone depends mainly on his mental conception, his inward imagination of the tone which has to be produced.

Certainly, one must not forget that the ability for inward conception of a tone, of several tones (a meaningful musical sentence) develops in the process of realizing this inner conception. Retrospectively, the actual sonority influences and enriches the inner imagination.

The strength and sharpness of the inner conception guides the pianist's playing apparatus in finding its means for realizing this conception. Arm, hand and fingers will obey, adjust and produce exactly what the mind dictates. The ability for self-listening is, of course, an indispensable condition. To quote Walter Gieseking, "It is useless to look for the reason of the beautiful tone in some particular finger position or hand position; I am convinced that the only way to learn to produce beautiful tone is systematic ear training."[51]

It is hopeless to look for beauty of tone in some kind of pianistic movement. Sometimes young students are very curious to see the playing hands of a great pianist, believing that thus they can find the secret of good tone quality. They should listen rather than look. Visual perception without inner conception is of little help: it can lead to quite wrong conclusions.

John Field was famous for his singing tone. His contemporaries told how he played the piano with fingers standing almost perpendicular to the keyboard. His beautiful tone was explained, quite seriously, by this hand position.

It is more ridiculous to explain a pianist's tone quality by the form of his hand and fingers. According to Edwin Hughes, Leschetizky attributed the big, full, luscious tone of Anton Rubinstein to his broad, thick fingers with their cushioned ends. As if a bony hand would be able to produce a dry, thin tone only!

When discussing the quality of piano tone, people often disregard the fact that a single tone is meaningless and, practically speaking, does not exist in music. Of course, a pianist often has to use separate movements of his playing apparatus for each tone in a succession (nonlegato playing). Here we have to control the speed of the downward movement of a key to produce the needed tone volume. The regulation of the applied energy is not a hard task in this case.

There is a very strange misconception that for production of soft, separated tones the wrist must also be soft and pliant. But for the production of nonlegato tones, no matter how soft, the wrist and all other joints of transmission should be firmly set, to convey the needed energy to the keys. Only then is the pianist equipped to regulate the tone volume exactly and faultlessly. It is the slowness with which the key is depressed, not looseness of the wrist that produces the soft tone.

As soon as we proceed to the production of a row of connected (legato) tones, the problem becomes infinitely more complicated. Now begins the work on tonal line. Many theorists stumbled over the description of this procedure. Nobody was able to give a comprehensible written explanation of the movements of the playing apparatus—still less, of the accompanying inner sensations.

Which part of the arm should be most active? Should one carry his hand "light as a feather," or should the weight of the arm—and how much of it—be transferred from finger to finger? How can one transfer this weight so that there are no jolts, so that the melody is perceived as a line and not as a succession of disconnected tones? One thing can be said here: the *idea of legato* calls forth a certain smooth movement between key pressures. This idea creates the proper physiological conditions. It is the idea of singing legato which represents the initial and most important point of departure.

RELAXATION AND TENSION

Formerly, piano teachers thought that the first step on the way to achieve independence of fingers was to try to isolate them from the "detrimental" influence of the upper parts of the arm. But finger movement is a very complicated function and is unthinkable without definite participation of these upper arm muscles. Finger independence is achieved with the ability to press a key and produce a tone without calling forth at the same time muscle tension of nonparticipating fingers.

Our whole playing apparatus (and this includes not only the arm and the muscles of the back but also the feet in operating the pedals) must be absolutely free in its movements and in its inner muscular functions. The action of the fingers and the upper parts of the arm must be fused in one motor form.

While the fingers and upper arm are self-sufficient parts of our playing apparatus, the parts between them form an integral system of levers. This system contributes to the increase of the radius of arm action. One of the basic functions of the upper parts of our playing apparatus is to put our fingers in the most convenient position for the best execution of orders given by the cortical motor centers.

I readily agree with some authors that the detailed knowledge of "names and addresses of muscles" is of no use for the development of piano technique, especially if we realize that much in muscle function is still unknown. But some empirical observations should be made.

The idea of relaxation is as absurd as that of weight playing. Both were born in the polemic ardor of arguments against the principles of the old finger school. Certainly, no pianist ever played by throwing the weight of his relaxed arm onto the keyboard.

In our motor activity there is a constant interchange of contraction and relaxation of muscles: a complicated interplay (synergy) of a great number of muscles and muscle groups. This gives us the feeling of resiliency and the possibility of regulating our motor activity in a definite way.

To perform any kind of work our muscles must contract. All muscle groups which move our body's parts are arranged in pairs and in such a way that they work against each other: if a contraction of one group of muscles causes a movement of one of these parts, the contraction of the opposite group causes the opposite movement of this part. Usually these two muscle groups do not contract simultaneously. Simultaneous contraction would cause stiffness of the concerned part, an unwanted overtension which, if prolonged, would result in a cramp.

But the normal muscle contraction is far from being a cramp and is absolutely necessary for any motor activity. A muscle is capable of any degree of contraction; the time of this contraction varies from a fraction of a second to the point where fatigue begins. For piano technique, the short-lasting muscle contractions are of particular importance. And so we should talk, not about relaxation, but rather about the degree of muscle contraction needed for this or that motor act.

Generally the degree of contraction is determined by the speed of movement and by dynamic shading. But the playing apparatus should never become stiff through excessive muscle contraction.

Thus the whole problem can be summed up in this way: by contracting the proper muscle, as much as necessary, at the proper moment, for as long as necessary, a pianist would avoid fatigue if he approached any new motor problem properly.

Although we cannot analyze exactly which muscles participate in this or that movement, we can still exert a limited control over their work. For instance, we can control the condition of the muscles of a finger not engaged in producing a tone at the given moment. The clearest example is to be found in the execution of a trill. Here the task is to obtain independence of fingers. Any unnecessary muscle contraction will prevent us from achieving a skillful and natural execution.

In the process of properly coordinated motor activity, the contraction of a muscle is instantaneously replaced by relaxation. In piano playing the form of movement and volume of sonority vary constantly—thus at every moment different muscles are involved in the action, and they all have sufficient time for rest.

Sometimes while playing a long tiring passage (for instance, octaves), a pianist will raise and lower the position of his wrist. With this change other muscles become involved in the procedure, and the tired ones get a needed rest.

We can find a simple illustration in our everyday motor activity. It is much more fatiguing to stand than to walk. In walking, muscle work is constantly redistributed between various muscle groups. When we have to stand for a long time, we gain relief from fatigue with the help of small movements, such as transferring our weight from one leg to the other.

Protracted contraction of certain muscle groups distorts the precise work of the cortex, thus hindering the perception of clear sensations from efficient movements—movements without muscle overtension.

Muscle overstrain produces a disturbance of the whole mental activity. Stanislavski, founder and director of the Moscow Art Theatre, proved this by carrying out an experiment. A student was required to lift and hold up a corner of a grand piano. While holding it he was asked to name several large cities and to say the multiplication table. He was unable to answer these very simple questions until he put his burden down.

Making excessive demands on muscles, in upsetting the metabolism in their tissues, decreases the efficiency of these muscles and does not increase their strength. It can even cause muscular atrophy.

On the other hand, absolute relaxation is not conducive to elasticity and latent readiness of muscles. It is weak static tension stimulating cortical activity that exerts the most favorable influence on muscle preparedness and innervation.

CHAPTER EIGHT

Coordination and Adjustment

ADJUSTMENT TO THE KEYBOARD

Let us artificially separate two aspects of piano technique in order to examine them. The first aspect is the mastering of the parts of our playing apparatus and coordinating these parts as a unit. This apparatus has to obey any order of our creative will.

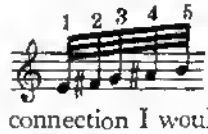
The second aspect is the adjustment of what Grigori Kogan has called "the compromise between the nature of the human being and the nature of the instrument." On the one hand there is our playing apparatus with upper parts of the arm forcordained to bring the hand and fingers of different length to the needed part of the keyboard and put them in the most convenient playing position. On the other hand there is the keyboard with its unequal distribution of black and white keys of different form and length, with a given depth and stiffness of action, producing certain effects according to whether they are held or released.

To be sure, this division of piano technique into two parts is purely theoretical, since we should not, and could not, develop one while ignoring the other. But various proportions of these two aspects come into consideration during various periods of study.

In the beginning, much attention must be paid to subordinating the playing apparatus to the beginner's will. Elements of adjustment should never be ignored, however: the world of practical pianism must be opened to a pupil from the very beginning. The practice of abstract exercises without practical application was one of the great deficiencies of the finger school. When the first stage—conditioning a path between nerve centers and periphery—is established and maintained, the aspect of adjustment gradually becomes more and more predominant in the technical development of a pianist.

It is evident, of course, that until the student achieves full command over his playing apparatus, the teacher should pay special attention to this point and find appropriate material for exercises. No exercise is good or bad by itself; not *what*, but *how*, is the most important consideration in practicing. On the highest level of the pianist's technical development, main attention must be directed to the adjustment of the obedient arm, hand and fingers to the diversity of technical tasks posed by musical demands.

It is adjustment which forces us to curve our fingers in different degrees, depending on their length and whether they are to play a black or white key. While playing the following succession of notes in the right hand, one has to curve the third finger as much as possible to achieve rapid and smooth movement without jerking the arm to and fro:



In this connection I would like to point out the difference in difficulty between B minor and B major scales. The latter is the easier because all short (black) keys are played with longer fingers, and long (white) keys with the thumb. In assigning the scales according to degree of difficulty, we have to consider the tempo at which the scale is supposed to be played (since the above mentioned adjustment is not hard to achieve in slower tempo) and the relationship of white and black keys and corresponding fingers.

Here is another example of adjustment. When playing trills, we change our hand position according to the given combination of white and black keys. If we drew an imaginary line between the points where our fingers touch the keys, the most convenient hand position would be that in which the axis of the hand is perpendicular to

this imaginary line. Thus, it is sometimes preferable that the fingers not form a straight line with the keys. The following illustration shows the position of the hand for a trill played between *b* and *c* sharp by fingers 2 and 4 (notice that in trilling it is better not to use adjacent fingers if possible):

When playing octaves, observe the following points: (1) Touch the white keys as near to the black ones as possible and touch the black keys near their edges. (2) Keep the wrist at the same height for white keys as for black.

All these and many other adjustments should be accomplished by elaboration, with participation of logical reasoning, visual and sensory control and, finally, with auditory appreciation of the results. Of course the *wise* body, even when an intellectual, analytical approach is lacking, could find its most convenient positions and movements in a given situation, though usually after long fumbling and floundering. The physical (motor) action must always be preceded by clearly and precisely hearing in the mind's ear the end-results for which one is striving. This is the indispensable condition for success.

FINGER DEXTERITY

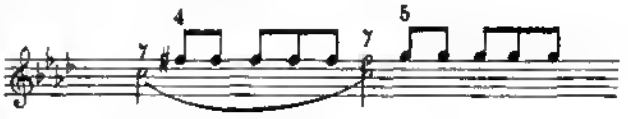
Since the earliest period of the history of piano playing, the main preoccupation of teachers has been to develop finger strength and finger speed. For two hundred years there have been suggestions for developing what we possess in more than adequate degree. The fingers of a newborn child are strong enough to sustain the weight of his body when he grasps a support. It is hard to find the origin of the absurd idea that strengthening the fingers would increase their agility.

Oscar Raif showed that the problem of velocity lies not in the speed of any individual finger, but in dexterity of mind. This means the easy and rapid perception of given musical material and the rapid transmission of volitional impulses from the central nervous system to the periphery—that is, to the playing apparatus. Any disobedience in the fingers is caused by deficiency in the transmission of orders.

Persistent concentration is necessary to achieve the finest precision in timing successive finger movements. Thus, using numerous and diverse rhythmic variants in scales and exercises created out of actual musical situations is a very good means for mastering that timing. The greater the variety of rhythmic combinations, the better. The constant alteration of rhythmic patterns helps achieve the necessary flexibility of pertinent nervous processes.

When a pianist has trouble with his fourth finger in a passage like this one in Chopin's F minor Etude Op. 25. No. 2:

to suggest practicing in this way:



lifting the fingers "as high as possible" and striking strongly, would show misunderstanding of the problem. Though piano playing consists of movements of fingers, the real problem lies not in the movement of the individual finger, but in precisely timed successive movements of several fingers. One of the difficulties of this Etude lies in exact timing of the natural accents—triplet eighths in the right hand against triplet quarters in the left—which, of course, should be felt rather than heard.

Often a student will complain that his fourth finger is weak. But this only shows that he does not know how to use it, that his adjustment is insufficient. Looking at the position of his hand and fingers on the keyboard, we immediately see the reason for his complaint: his hand is in supinated position (sloped down toward the fifth finger); the fourth finger is at an angle and consequently feels weak. But the fourth finger, although generally weaker than the third, is still strong enough for piano playing. Pronation of the hand improves the situation immediately by bringing the fingers into position so that each will

stand straight and be in direct line with the key it is going to press, and, as far as possible, with the forearm.

It is also necessary to achieve firm stability in the fingers and wrist so that weight and energy applied from the upper arm will be transmitted directly and freely to the keys. Under these conditions all fingers will be equal and strong enough for piano playing.

So I say, though it may seem astounding to some: the piano teacher should not direct special attention to the development of individual finger speed and finger muscles.

SPACIAL ORIENTATION

Exercises within one hand location contribute little to the broad technical development of a pianist. The succession of notes (fingers) is perceived rather easily, and the corresponding finger movements and helping movements of the upper parts of the arm soon become automatic, except in rare cases.

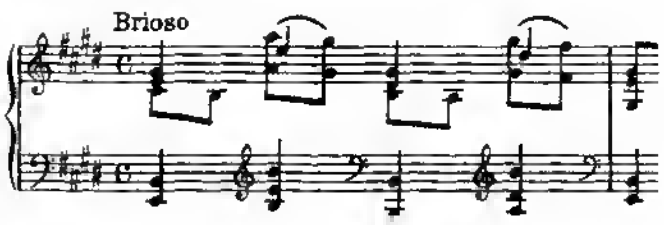
What is more difficult in piano playing is to estimate distances, both in shifting the hand to a new location (especially to a far lying group of notes) and in finding instantaneously the new relative positions of the fingers within this new hand location. These new positions should be anticipated and formed while the hand is moving to its new place, as if they were first prepared in the mind.

Spacial orientation on the keyboard is very important and represents quite a problem, especially since the modern keyboard has asymmetrical disposition of black keys. Thus, the same interval sometimes requires not only different positions of the fingers (depending on black and white keys), but also different stretches for similar intervals and similar combinations of white and black keys. For instance, the following are all intervals of a minor third but differ in width: $f - ab = 35$ mm., $c - eb = 38$ mm., $g - bb = 39$ mm.

A simple example of spacial orientation of the playing apparatus requiring estimation of distances within a hand location is to be found in Chopin's Etude Op. 10, No. 7:

Both fifths and sixths are played with fingers 2 and 5; the pianist has to adjust the stretch between these fingers, sometimes widening it (sixths), sometimes narrowing it (fifths). Metrical accents, falling each time on the fifths, form very convenient, easily preceived patterns.

Scriabin's Etude Op. 8, No. 5 represents a much more difficult example:



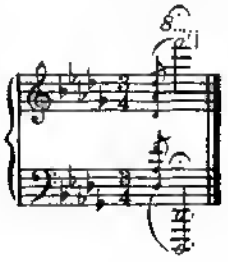
In this case, while carrying his arm from the lower to the higher register and back, the pianist not only has to find the new location swiftly. He also has to anticipate distances within each next location and form chords correspondingly, first in his mind and then in his hands, by correct positioning of his fingers.

In the following spot in Chopin's G minor Ballade we have a slight complication:

When playing the bass notes, the left hand should be in exactly the same position in relation to the keyboard as it has to be to play the next chord. The hand position changes while carrying the arm to the left, to the next bass note, anticipating the needed position for the following chord, Twisting the hand while carrying it from bass note up to chord would ruin the execution of this passage. Practically speaking, we have two different positions of the hand (photographs 1, 2, 3, 4):

1. ON E FLAT

There is an interesting instance of leaps in both hands simultaneously in the finale of Chopin's B-flat minor Scherzo:



This problem is often considered extremely hard to solve. But the solution is relatively simple because the pianist here has sufficient time for preparation. This should consist of two actions: (1) the actual preparation of both hands for the chords written in small notes; (2) an instantaneous glance with the corner of the eye to the left, to the lower octave. Now the eyes should shift to the right to guide the motion of the right arm to the top *f*, which must be taken with the third finger. I emphasize that the upper arm should be moved, with no attempt to stretch out the hand or finger in the direction of the high *f*, and in such a way that hand and finger form a straight line with the key. While attention is now concentrated on the right side of the keyboard, the left arm is carried to the left and finds the lower octave without visual control. The distance was estimated by that quick glance, and the precision of performed movement is based on visual-auditory-motor response established during many years of playing the piano.

Not only is timing of finger movements important; extremely precise timing in coordinating the work of all parts of the playing apparatus is indispensable. When playing any passage requiring a lateral change of position of the whole playing apparatus (an extended scale, for instance), well-timed spacial coordination of the movements of fingers and upper parts of the playing apparatus is obviously of utmost importance. Evenness and smooth fluency of execution depend on this coordination.

When studying a passage requiring lateral shifts, one would do well first to try general movements of the arm silently, adapting these to the given situation and aiming for plasticity of the whole playing apparatus. Only after working out the general projection as well as fluency of these movements should one start to coordinate them with fingerwork.

REGULATION OF ENERGY

Another important step in technical mastery is the pianist's development of the ability to regulate volume of tone. The degree of loudness of a tone depends on the speed with which a key is pressed down. Physiologically this means that one has to put a definite amount of energy into his playing apparatus to be able to press each key with exactly the needed speed to achieve the needed volume of tone. The precise distribution of this energy and the precise timing of this distribution, which presuppose very fine neuromuscular activity, should always be the center of attention of both teacher and pupil. Making accents, increasing and decreasing tone volume, sudden and abrupt changes in dynamics (somewhat more difficult)—all depend on the amount of energy directed toward a key.

Key pressure is not effected through the work of finger muscles solely, as the old finger school thought, but through synergy of muscles of the whole playing apparatus. The regulation of speed of the downward movement

2. ON THE FOLLOWING CHORD

3. ON B FLAT

4. ON THE FOLLOWING CHORD

of a key is much more easily and securely realized if it is initiated at the shoulder.

We do not know exactly which muscles are involved when we are producing this or that degree of volume. The question of *what* we should and do apply to the key —passive weight or active energy—has always been a point of controversy. However, it is known in mechanics that with the increase of the weight of a load, speed is decreased, and that in mechanical work it is better to increase speed at the expense of weight. This contradicts the principles of the "weight-playing" of the anatomic-physiological school. Actually, we apply both weight and active energy to the key in constantly changing proportion according to the requirements of the musical purpose.

Regularity in strong metrical-rhythmic feeling is of utmost importance in piano playing to make the nervous mechanism operate effectively. This means that the groups into which we divide a given passage should be of the same duration.

Often the failure in execution of a scale, trill or tremolo is hidden in incorrect timing of accentuation. Sometimes a pupil tends to make an accent on a definite finger instead of on a definite note of the group, or makes other accents in addition to the correct ones.

If a pianist plays a passage without regular natural accentuation (these accents should be very light, hardly audible), no matter how distinct his finger work is, he will give his listeners the impression that his playing is somewhat indistinct. Regularity of metrical division is important for clear auditory perception of performed music as well as for execution.

Besides the strict observance and correct execution of prescribed accents and dynamics, the ability to distribute energy correctly can be developed successfully by applying numerous metrical variants to exercises, scales and passages in compositions, as well as by executing scales and exercises with various dynamic shadings. When any exercise, scale or section of a passage is singled out for practice, it must always be divided into clearly accented, regular metrical groups. It must also be finished on the strong beat to give a proper feeling for the end of the unit.

Since the development of the ability for proportional distribution of energy is of such great importance, any mechanical contrivance, such as those described in Chapter 1, represents an impediment to technical development. Similarly, exercises with four fingers pressing the keys silently while one finger is working are also harmful. These unnatural forms of practicing deprive the pianist of the opportunity to develop his ability for the fine regulation of energy with which each key has to be pressed.

CHAPTER NINE

Mental Work

MENTAL DEXTERITY

We cannot read a row of nonsense syllables quickly because we are unable to unite these syllables into meaningful words and sentences. Practice in repeating them would not be of much help; only when grasping the sense of what we are reading can we read quickly.

As the swiftness of our speech apparatus depends on our ability to think quickly, the agility of our motor apparatus depends more on our ability for fast musical thinking than on long practicing and numerous repetitions of movements. Practicing of the motor apparatus cannot be dispensed with, however, in the development of this fast thinking.

If technical insufficiency (unsuitable motor activity) can sometimes be caused by failure to find the appropriate position and movement forms of the playing apparatus, it is usually a symptom of undeveloped musical thinking. The reasons for the trouble should be looked for in the central nervous system.

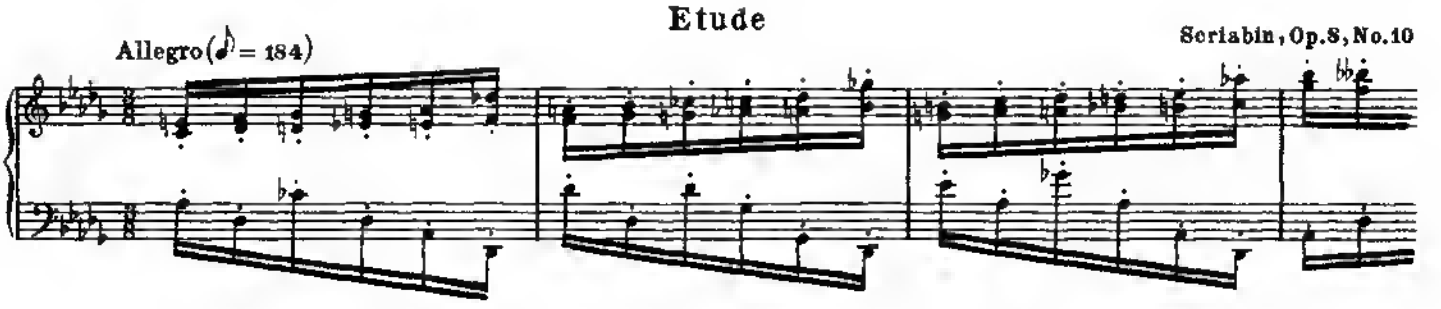
"A player's fingers cannot travel faster than the thoughts which direct his fingers on the keyboard. Therefore his velocity depends first on his mental agility in grasping printed music and coordinating finger movements."[52]

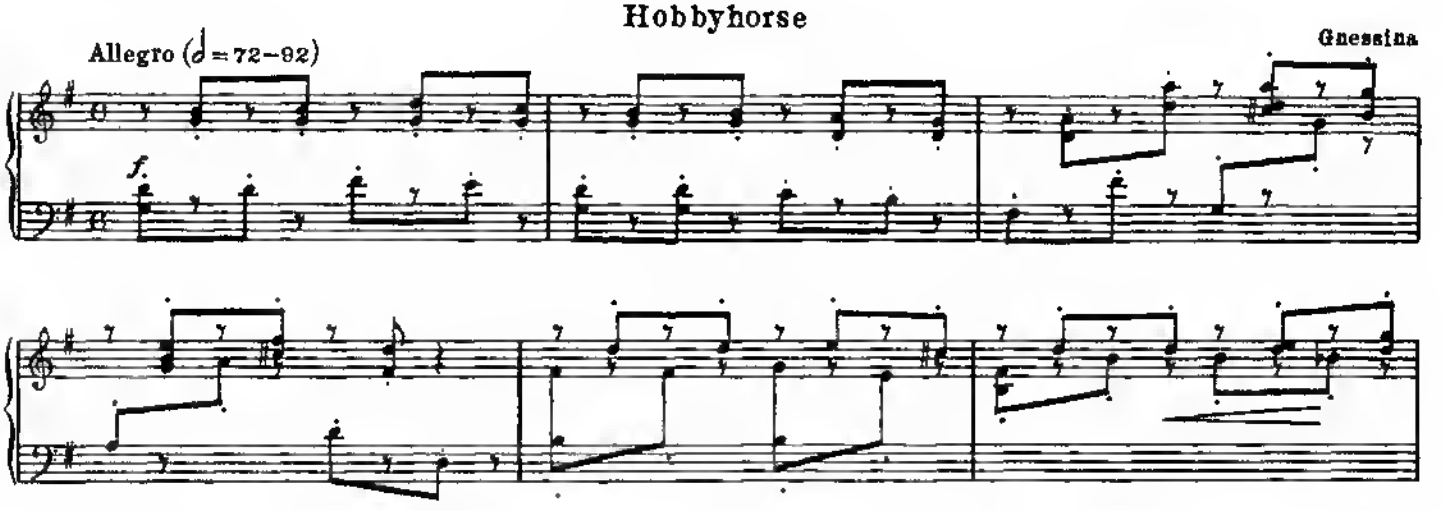
In reading music the pianist should not read single notes but should unite these notes in comprehensible successions: arpeggio or scale patterns of any kind, any kind of sequence, harmonic complex, and the like. In order to be able to play with speed, we have to organize our thinking in such a way that it will flow rapidly and unhampered.

If we try to play a scale or passage without dividing it into several groups with regular accents, then for each movement of each single finger a separate will-impulse must be sent from the central nervous system. In this way we would be able to play our scale in slow tempo only. Uniting two notes in one group by an accent on the first note will enable us to play a given succession somewhat faster because now only one will-impulse is needed to produce two tones. The faster we want to play, the greater the number of tones that have to be united into one group. Thus, many volitional impulses, each directed to a single action, would be replaced by a few directed to the compound action. For exceedingly rapid scale playing (in the finale of Chopin's G minor Ballade, for example), we should unite seven notes in one will-impulse. By doing so we gain the advantage of playing the regularly repeated patterns of notes and finger successions with octave orientation. Because of this orientation, it is easier to unite seven notes in one group than six or eight. Thus, at each strong beat we send a will-impulse and are not conscious of the notes which are played between these strong beats. These links have been worked out previously and stored in the motor region of the cortex.

When one can play any section of a difficult piece in the required fast tempo but fails to play the sections in continuity, it is clear that the real difficulty does not lie in the domain of pure motor activity. Rather, it is the inability to think fast enough to estimate the distances and to anticipate and prepare one's playing apparatus for each situation without the slightest delay.

As striking illustrations of this problem, I can point out the Scriabin Etude in D-flat major Op. 8, No. 10 and the incomparably easier *Hobbyhorse* by Gnessina. Both of these present the same type of problem. A solution to the problem would require the same approach in either case, in spite of their disparity in difficulty.





The purely motor problems in *Hobbyhorse* are not hard: (1) alternating movements of the right and left forearms; (2) preparation of correct finger disposition within each frequently changed hand location. To learn to play any short section of this piece fast would not be difficult for a pupil in the third year of his piano study, even one with only average capabilities. In fact he would soon also be able to play it fast in its entirety, but with frequent stops at definite points: at the end of each measure or every two measures. During these stops he would have an opportunity to prepare himself for the next section. But to learn to play this piece fast and without stops the pupil would have to learn to *think fast.*

GROUPING AND REGROUPING

Regularity in the repetition of patterns is not the only factor which makes playing a scale or passage simpler. How it is divided metrically—that is, on which note (finger) the accent falls—is important.

Try this experiment. Play the G minor scale very fast with the left hand, accenting only the *g*'s in each octave:

Now change your approach and accent the *b* flats, dividing the scale in this way:

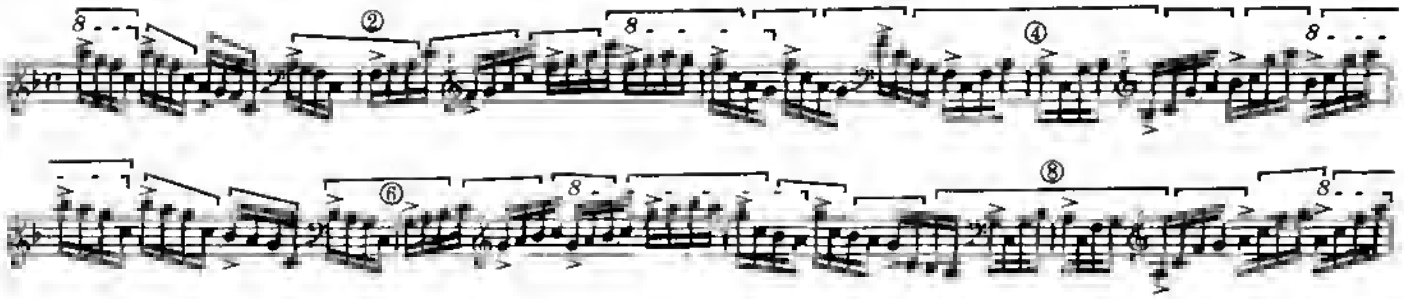
Play a B major scale with the right hand starting from *g* sharp and so accenting all *g* sharps. Then, starting from *b*, play the same scale and accent all the *b*'s. Do the same with the F-sharp major scale (either hand), accenting first the *g* sharps, then the *f* sharps.

These examples could be multiplied, but they will be sufficient to show wherein the difficulty of execution sometimes lies.

It is very instructive to try to facilitate a passage by rearranging the accents, that is, by changing the metrical grouping. The following passage from Moszkowski's *In Autumn*:

could be made to seem somewhat easier:

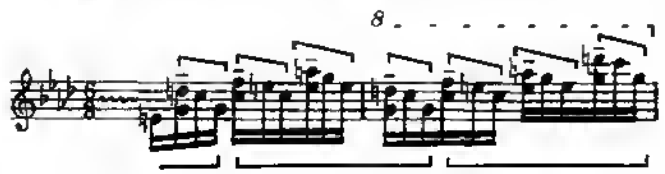
In the first eight measures of his Etude Op. 10, No. 8, Chopin presents such a rearrangement—a different accentuation in identical passages. This difference makes some measures seem easier to play and others less so. Evidently the composer deliberately set this task for the performer.



In the first three measures, while shifting the arm to a new location, one has to keep the finger positions within the hand unchanged. Of course, no rigid positions are meant by this, and the fingers must be able to adjust to the new configurations of this passage in measures 4, 6 and 8. These forms are prepared, anticipated in the mind, and kept in the sensorium. Thus, one does not have to connect *c* with *a* in the first measure and *a* with *c* in the second, but rather *a* with *a*, *c* with *c*, and so on. Spacial coordination and timing of finger and arm movements are of utmost importance for the fluent performance of this Etude.

Temporary simplification of a passage by replacing the prescribed accents with more convenient ones often helps overcome a difficulty. The passage first played in simplified version comes into the fingers easily. Then after smooth execution is achieved, restoring the prescribed metrical groupings will not cause any significant difficulty.

In starting to practice the comparatively easy passage below from Chopin's Ballade in A-flat major, one could first change the meter and play triplets (marked by the brackets above the notes) and afterwards unite these triplets into larger groups (marked by the brackets below the notes), thus having an exactly repeated pattern.



Of course, the correct accentuation must eventually be restored.

And so we approach the question of mental regrouping—disregarding the prescribed metrical forms and uniting the notes in differently organized groups.

The composer is subject to certain rules. He divides his composition by measures and by definite metrical groupings. Often this division does not correspond to the real musical sense (phrasing, melodic line, design) and is very inconvenient technically. Mental regrouping offers an immediate opportunity to overcome some technical difficulties and therefore makes execution much easier.

Grigori Kogan suggests a parallel in the domain of speech. Suppose we had to pronounce the syllable ***ackb ackb ackb*** a great many times in succession and very fast. According to the rules of the finger school, to acquire speed we would first need to repeat each single letter separately for a period of days, or even weeks and months, energetically moving the tongue in all directions—up and down, to and fro, to the right and to the left. Then we would have to repeat the whole syllable again many, many times until we were able to utter it in the required rapid tempo.

The anatomic-physiological school would recommend studying the anatomy of the speech apparatus, to understand which muscles were involved in this action and how to use the proper muscles only, carefully controlling relaxation. Quick success without boring hours of drill would be promised.

Mental regrouping offers a more reasonable solution to our problem. Reorganizing the syllables in this way:

ackb ackb ackb ackb enables us to repeat them very fast and without any practicing at all.

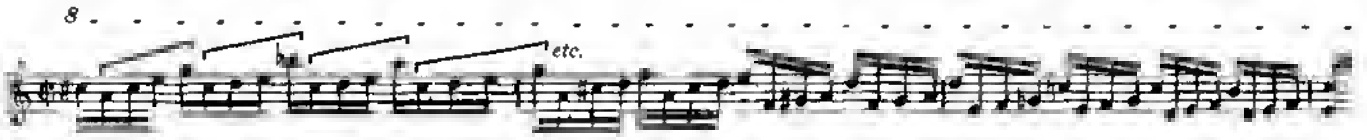
Ferruccio Busoni was the first to explore the problem of mental regrouping and to introduce, as distinct from musical phrasing, the term "technical phrasing." Although his analysis was concerned with octave technique, his considerations apply to other forms of piano technique as well.

Mental regrouping must be based on keyboard structure, fingering and design of musical line. Guides in making convenient groupings are:

1. Fragments within which the notes move in one direction.
2. Regularity of movement when uniform groups are repeated (repetition of similar movements).
3. Notes which can be grasped in one hand location.
4. Constructions in which the last note of a group comes on an accent.

The beginning of the Cramer-Bülow Etude No. 1 in C major can serve as the simplest example of regrouping (marked by brackets) according to these four conditions:

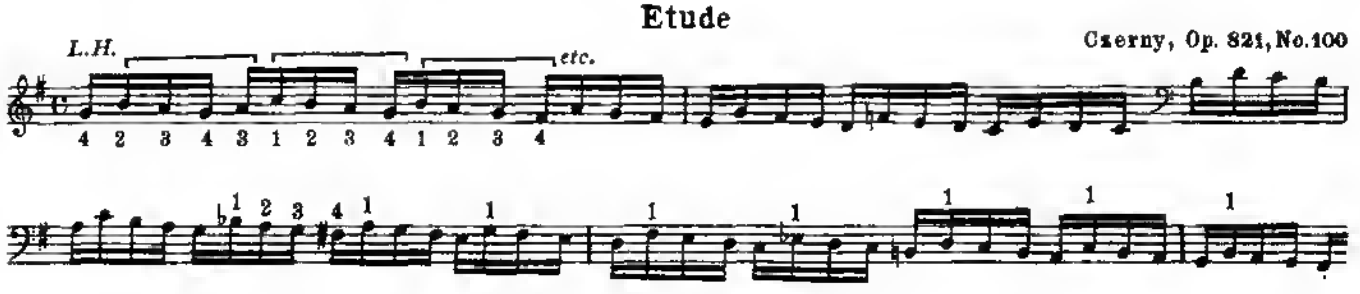
Another practical and striking example can be found in the last measures of Czerny's Etude Op. 299, No. 6. Visualizing this passage as it is marked by brackets, we clearly see it in two parts: (1) as a descending row of single top notes and (2) as a descending sequence of similar patterns consisting of three ascending notes. The whole "acoustic picture" is easily lodged in memory. Through mental regrouping, playing this section suddenly becomes much easier: the passage at once gets into the fingers and the unifying rounded arm movements appear spontaneously. This example also illustrates all four conditions for convenient grouping.



Sometimes by regrouping we almost seem to avoid leaps:

Instead of a succession of octaves and tenths, we get a succession of octaves, easily perceived and performed. Of course, we have to keep the correct accentuation, and after first playing, in groups of two, we must restore the triplets, still thinking in twos.

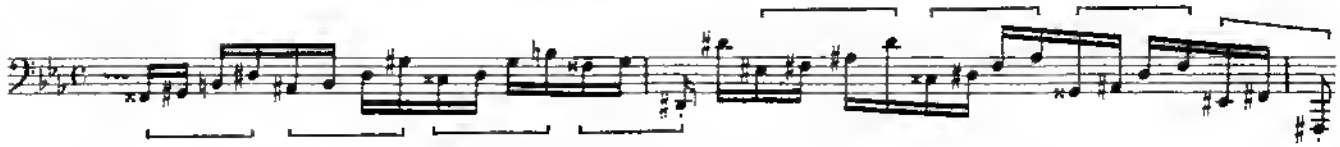
Any number of examples of regrouping, including the following by Czerny, can easily be found at almost any step in a pianist's study. Although adherents of the old-fashioned approach would find the indicated fingering inconvenient, what seems to be more difficult for the fingers is easier for the mind. Mental convenience is worth more than motor convenience.



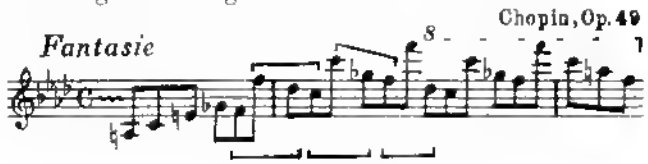
The following left-hand passage from a Haydn Sonata in C can first be regrouped as indicated by the brackets above. Then, by regrouping according to the brackets below, two short groups are united as one, allowing the repeated succession of fingers 1 2 3 2 3 4:

More difficult examples are found in Chopin's Etude Op. 25, No. 11:

and in his Etude Op. 10, No. 12:

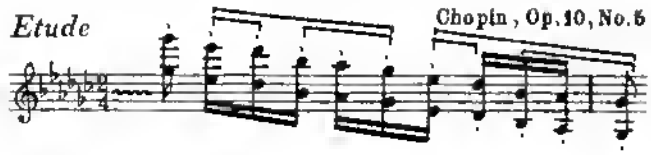


In the example below, there is a choice between two regroupings: in one (brackets above) the notes move in one direction; in the other (brackets below) there is the advantage of endings on accents.

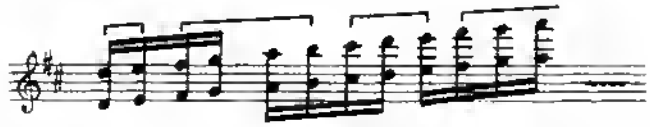


For the grouping of octave passages, points 1, 2 and 4 mentioned on page 48 apply. To these we now need to add two more considerations:

5. The sameness of the intervals in the progression.

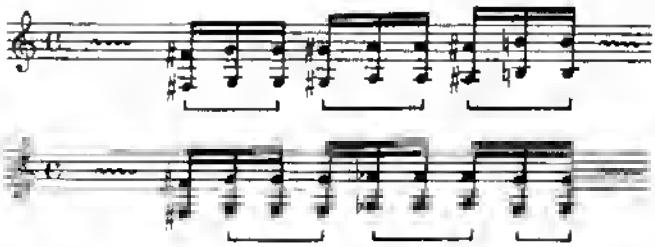


6. As far as possible, beginning each group on black keys and ending on white keys, as it is more convenient to go from black to white keys than from white to black.



In the following example the regrouping indicated by the brackets above the notes requires only a simple sideways movement to retain the convenient succession of seconds. In the grouping indicated by the brackets below the notes, the main motor difficulty—changing the direction of lateral movement of the arm, together with inconvenient shifting of the arm from white key (*e*) to black (*c*♯)—happens to be within the group. In the former grouping this difficult point coincides with the beginning of each group, when the application of will-impulse is necessary anyhow. But in the latter grouping, to overcome the indicated difficulty would require special attention, the application of two will-impulses for one group of three notes!

Two similar measures in the Chopin C minor Nocturne would be regrouped differently. In the first, in each group the hand glides easily from black to white keys; while in the second, in each group the hand remains over the same tone.



The regrouping discussed in this chapter "should be audible only to the player, and in public performances should properly form only a mental, not a physical, factor."[3]

Regrouping is not a recent clever invention. Its origin lies in the nature of piano technique. Every pianist comes to it, if most often unconsciously. But blind groping is uneconomical. It takes too much time. When faced with a new passage, one should understand the general underlying principle or be forced to look for a new solution each time. With a knowledge of methods and of the anatomy of a passage, work can be organized rationally from the very beginning.

MENTAL PRACTICING

"The full acoustic picture of the music must be lodged in the *mind*, before it can be expressed through the *hands*." Then the "*playing* is simply the manual expression of something [a pianist] knows."[54]

—Josef Hofmann

Since the purpose of pianistic movement is the realization of the acoustic picture, the pianist must perceive this picture in its whole complexity. He has to be fully aware of all problems which lie before him, to know exactly what he is going to do, to anticipate the actual playing before his hands touch the keyboard.

Before playing a composition he has to become familiar with its form, harmonic and polyphonic structure, metrical-rhythmic relationships, melodic design, phrasing, articulation, quality of desired sonority and dynamic shading. He has to consider technical questions—positions and movements of his playing apparatus, kinds of touch and appropriate fingering. Naturally, some of these elements, which involve a pianist's personal approach and refer to interpretation, can be changed during later work on the composition. Sometimes even fingering can be changed.

It should be a rule that everything has to be played without mistakes from the very beginning, to save time and energy. Thus, one will be spared getting rid of undesired conditioned reflexes which have been established while practicing—wrong fingering, wrong rhythm (especially hard to correct), or anything else.

To be able to play a musical composition correctly the very first time, one should observe the following procedures:

1. Analyze the musical composition and clearly comprehend all its elements.
2. Play only at a tempo which will allow absolute control over everything; acquire the attitude of looking ahead, anticipating each tone and the corresponding movements to produce it; control results by constant listening.
3. Make no attempt to play over the whole piece, or sections of it which are too long to be thoroughly thought out and prepared, and controlled exactly in their realization. The length of these sections should be determined by one's capabilities: the lower the level of musical and technical development, the shorter these sections should be.

If the whole acoustic picture is too complicated to be perceived at once, some or all of its elements should be taken separately and worked out thoroughly before being united again. This refers particularly to rhythm. If any rhythmic pattern is at all difficult to perceive, take this pattern out of the whole and work it out in the following way: First tap the rhythmic pattern of each hand separately. Now play this section with one hand while tapping the beats with the other. Then, if rhythmic coordination of the two parts happens to be hard, tap these patterns simultaneously with both hands. Repeat this procedure until the rhythm is fully sensed.

Each part (voice) should first be perceived clearly and practiced separately, especially in polyphonic music. Then take two voices together in various combinations: soprano and alto, soprano and tenor, soprano and bass, alto and tenor, and so on, proceeding similarly to combinations of three voices.

In choosing fingerings, the pianist should take the required tempo into consideration, since fingering often depends on the speed of finger succession.

Mental work is not only important as preliminary preparation before the actual practicing begins: it is also important at any period during the study of a musical composition if the pianist has difficulty in some spot. Then he must stop playing and try to establish a completely clear picture of the problem he has to solve. If the first step on the way to overcoming a difficulty is to notice (to hear) that something is going wrong, the second step is to discern the cause of the failure. Then one should think over how to improve the situation, how to find the best and easiest way to perfection.

The whole composition which is being studied should be read mentally from time to time. We must remember Busoni's warning that one easily forgets about the musical meaning during the motor work at the piano. By mental reading without actual playing we can revive the clear acoustic picture of the composition in our mind and are stimulated in our efforts to master it technically.

Besides, while reading silently one notices better what is written around the notes—the many important signs which might not have been observed during actual playing. As with anything stationary, visual impressions of the printed page are engraved on the mind more easily, accurately and with more stability than fleeting auditory ones.

The silent mental reading of a musical composition (or some section of it if needed) often helps better than actual playing to unite separate tones into meaningful musical lines. After perceiving the composition in all its logical connections and successions, one is able to follow inwardly the course of its sound in faster tempo, and thus play it as fast as needed.

Walter Gieseking once said that the main factor in technique is the brain; the main condition for technique is concentration; and the main subject of technique is evenness.

Deep, strong concentration is meant here, concentration excluding everything irrelevant. While practicing, a pianist should be completely absorbed in his activity at the instrument. Often he has to watch several points at once: hand position, form of movement, fingering, musical qualities of his execution and so on. How many points he can have under his control at the same time depends

on the level of his development. If in practicing he leaves one point unobserved, this whole practicing could be not only useless but even detrimental. Wrong conditioned connections can easily be established in such a procedure.

A pianist must learn to hear the slightest differences in the quality of his tone, phrasing, dynamic shadings; to notice the slightest rhythmic and technical inaccuracies; to perceive the finest sensations in his playing apparatus.

But in the last analysis, anything conscious and calculated in piano playing must be transcended. Real creation does not lie in the realm of reason. The finest gradations in tone volume, in rhythm (agogics), and in other elements of performance are incalculable, and have to be felt as nuances of musical expression. When performance projects a kind of spell over the audience, when the tonal beauty seems ethereal, this is achieved, not by any kind of calculation, but by inspiration.

In this spirit we have to understand the words of C. A. Martienssen: "The pianoforte begins to reveal its never attainable final sound-wonders on an irrational basis only."[55]

When some authors speak out against using terms they find inaccurate, as, for instance, "singing," "warm," "harsh" tone, "colorful" sonority and the like, they disclose an absence of imagination. If I regret that in the *technical domain* of piano playing we have to resort to vague definitions and metaphors, I admit that on the highest creative level, the level of non-verbal symbolism, such metaphoric language can enrich the imagination.

Interrupting this short excursion into the irrational, however, let us return to the main factor in technique. The student has to be taught not only how to play but also how to think, how to organize his process of practicing. This refers to the sequence of the material studied, the time given to each part of the work, as well as to the detailed approach to all the problems encountered.

While no book can replace live teaching, this book has offered certain suggestions for practicing. Following them, one sees that mechanical difficulties are not as significant as one might think. Comprehension, discipline, patience and sheer grit play a decisive role in efficient practicing.

The best indication of real progress is the student's independent work: how well and how far he can go by himself in mastering a new composition as a whole, in solving new musical and technical tasks.

CHAPTER TEN

Stage Fright

Stage fright, the thought of possible failure mixed with the hope of success, creates excitation in the speech region of the cortex which tends to spread over the whole cortex. The excitability of some nervous elements, often irrelevant to the present activity, is heightened, while the excitability of others, important for the normal flow of this activity, is partly or completely repressed.

Any extra nervous excitation can immediately diminish or abolish established conditioned reflexes, even though only temporarily. Thus, a state of confusion is created, the equilibrium of nervous processes is disturbed, sometimes to a harmful extent. Yet the stronger and more durable the established conditioned connections, the stronger their resistance to unwanted influences of interfering nervous agitation.

Long before a performance, just thinking about it can send waves of excitation from the speech center to other points of the central nervous system. This expresses itself in heightened irritability, nervous trembling, and even influences the activity of the vegetative nervous system.

During the performance, waves of this excitation irradiate over the cortex. Irrelevant thoughts flash through the brain, disturbing the normal course of nervous processes in piano playing. Several other stimulants, such as the stage itself, its arrangement, unusual lighting, an unfamiliar piano, to say nothing of the presence of the audience, are added to the initial excitation.

If the waves of incoming irrelevant excitation are extremely strong and meet the weak nervous elements, the latter, excited over their set limit and overstrained, will develop preservative transmarginal inhibition, which can suppress the excitatory process. Fingers do not obey, they stumble. The pianist's activity can stop completely.

Even if the irrelevant excitation is not so strong, it spreads over the cortex, reaches the points where the principal activity takes its course, and could disturb this activity, unsettling inhibition and affecting precision. The playing becomes uneven, the innervation of movements, premature.

Stage fright augments all ordinary defects. The performer will be unable to regulate the energy of movement, hence the quality of tone, to the detriment of dynamic shadings. Earlier mistakes, which were corrected, will be revived.

Sometimes the influence of stage-fright excitation can heighten the mobility of nervous processes and increase velocity, but, at the same time, this brings some danger. At every difficult spot, transmarginal inhibition can develop. Weak nervous processes will be inhibited before the finger has reached the keybed; hence the tone becomes superficial. Transmarginal inhibition can also cause a sudden block in memory. But these are extreme cases, and if the basic nervous processes are strong enough and the incoming waves of extraneous stimulation are not too intense, the increase of excitation will not exceed normal limits and will even help the performance.

This excitation, not upsetting the inhibitory process, can improve and strengthen the main activity. A large brightly lighted hall, the stage, and especially a sensitive audience following attentively will inspire the performer. The state of enthusiasm will enrich and carry forward his artistic imagination. His penetration into the music becomes finer and deeper, his inner hearing becomes more intense and in turn helps his motor functions. He will play even better than he ever played in more usual circumstances.

Svyatoslav Richter tells us: "The music subjugates you and does not leave place for idle thoughts. Now one forgets everything—not only the public but himself as well."

Self-oblivion is granted to very few artists and is possible only with the possession of perfectly automatized motor activity. Usually, inspiration combined with constant self-control is the ideal state of mind of a performing artist.

A satisfactory performance in usual circumstances (at home or during a lesson) does not indicate that under the stress of the concert stage all nervous processes will take their course in perfect balance. The stage influences nervous activity greatly and makes much greater requirements. Therefore, in preparing for a concert performance, the pianist should constantly keep in mind that he has to create a kind of reserve: in his tempo limits (always being able to play faster than he plans to play in concert) and in his ability to regulate the timing of his motor acts and the volume of his tone. He has to train himself so that an unusual situation will not impede the normal flow of his nervous processes and distract him from his main occupation—unfolding the musical image under complete control. He should seek opportunities to play before people, under the most taxing conditions possible.

Training for concert performance is especially difficult if the student has previously experienced failure. Even the vague memory of those strong stimuli which originally evoked the nervous disturbance would affect the normal flow of his nervous activity.

There are few performers who are not agitated before a public appearance. Neither great talent nor vast experience, nor the best physical and physiological conditions are a guaranty against this kind of stage fright.

But the stage fright of a novice must not be confused with the nervousness of a great artist. The latter feels his deep responsibility to both composer and audience whom he serves as intermediary. It is a great obligation which he has to fulfill on the highest possible level.

The decisive moment comes when the pianist, sitting at the instrument, having found the convenient posture and having checked everything (height of chair, lighting), is waiting for silence in the hall and trying to concentrate. He first has to start to perform inwardly, hearing clearly the beginning of the piece, its character, exact tempo and tonal volume.

If the pianist succeeds in his concentration, his nervousness immediately disappears with the beginning of action. Sometimes, however, he overcomes his fear gradually and doesn't feel comfortable until after playing the first composition or even later.

Negative self-suggestions, such as "not too fast," "not too slow," "not too loud," "quiet down," are insufficient. We cannot regulate our nervous excitement directly in most cases—no logical reasoning can help—but we can influence it indirectly.

When the performer is wholly taken up with what he is doing on the stage, there is no possibility of any irrelevant thoughts interfering. Strong concentration on concrete artistic problems, on the musical image, inductively suppresses the harmful influence of any irrelevant stimulations. The greater the requirements put before the pianist, the busier and the more absorbed he is in his creative task and the less accessible to these unwanted influences.

Deep penetration into the musical composition being performed is prepared by a long period of elaborate and minute consideration of its details. Thus, the quality of a performance depends on the quality of the preceding preparation. I would like to emphasize that the most careful, detailed preparatory work helps more than anything else to overcome stage fright.

It is important to remember that strenuous preparatory work can result in weakening the function of the cortical cells. Therefore, the pianist should avoid overfatigue in his daily practicing, especially as the concert date approaches. Practice very little the day of a concert; just warm up the playing apparatus and on no account play the assigned pieces. The slightest weariness of the cells of the cortical motor region, imperceptible in an ordinary situation, could have unfavorable results when excitability is heightened.

Svyatoslav Richter believes that the pianist must practice even on the day of a concert, and a great deal—about six hours (!). However, he never plays over a piece in its entirety, only sections of it. Here I would like to add that one should be very careful in listening to what great pianists tell about their preparatory work, and especially in following their suggestions. Most of them make contradictory statements; above all, they are geniuses and genius has its own laws, not applicable to mortals.

There are some other methods for successfully overcoming, or at least lessening, the detrimental influence of stage fright. The better trained the process of inhibition of a given nervous system, the greater the efficiency of the cortical cells, the less harmful is this influence. Slow, measured movements, proceeding to the piano on the stage slowly, deep, quiet respiration can have a salutary effect. Not only is our inner state of mind reflected in our outer conduct, but our outer conduct can strongly influence our inner state of mind.

The development of inhibition takes a long time, but everything in such a complicated process as the development of a pianist requires long, unremitting work.

Conclusion

In the last decades, something has been contributed toward a really scientific approach to problems of piano playing, and enough is now known to guard against many fallacious ideas of the past. But the relevant sciences—reflexology, neurology, histology, muscle physiology, biomechanics, biochemistry—still give insufficient information for absolute comprehension of motor processes and control over them. Some ingredients of these processes have not been thoroughly studied; some questions remain as yet unanswered. We can definitely hope, though, that with scientific progress, more and more light will be shed on the nervous processes governing our motor activity.

Until science has no unanswered questions, no work based on current concepts of neurology and reflexology and muscle physiology can be looked upon as final. Therefore, while outlining in this book a new scientific approach to some problems in the development of piano technique, I do not claim my work as final. It is just a beginning.

I do not believe, however, that piano playing will ever be founded and developed exclusively on a scientific basis. The human factor—individual differences, personal taste, opinion, feelings—does not yield to a completely scientific analysis. This human factor will always occupy a very important place in piano playing and influence the process of realization of artistic ideas.

While striving to give as much scientific foundation as possible to our technical work, I still hope that there will always be a place in piano playing for inspiration of a high order, and that wealth of imagination will be the decisive factor in great performance.